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DEMILITARIZATION PLAN: OPERATION OF THE CHEMICAL AGENT MUNITION--ETC(U)
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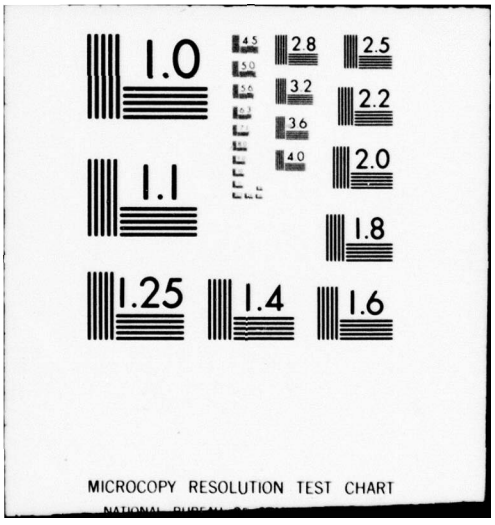
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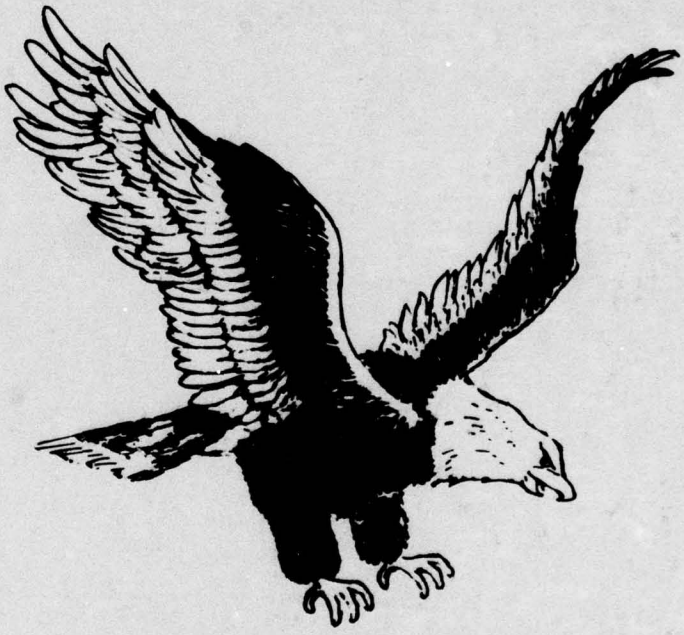
MICROCOPY RESOLUTION TEST CHART

LEVEL II

(1)

OPERATION OF THE CHEMICAL AGENT MUNITIONS DISPOSAL SYSTEM (CAMDS) AT TOOELE ARMY DEPOT, UTAH



MARCH 1977

INCLOSURE NO. 3

HAZARD AND SAFETY ANALYSES

DEMILITARIZATION PLAN

OPERATION

OF THE

CHEMICAL AGENT MUNITIONS DISPOSAL SYSTEM

(CAMDS)

AT

TOOELE ARMY DEPOT

MARCH 1977

INCLOSURE NO. 3

HAZARD AND SAFETY ANALYSES

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The Chemical Agent Munition Disposal System is a prototype facility for the large scale destruction of lethal chemical agents and munitions. This document is a failure modes and effects analysis based on design data and anticipated operating procedures.

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LEVEL II

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TRW REPORT NO. 95436-002

SAFETY ANALYSES AND HAZARD EVALUATION REPORT

FAILURE MODES AND EFFECTS ANALYSIS

FOR

CAMDS

2 OCTOBER 1975

SUBMITTED TO

TOOELE ARMY DEPOT
TOOELE, UTAH 84074

Prepared Under Contract
No. DAAG-49-75-C-0135

TRW ENVIRONMENTAL SERVICES
ONE SPACE PARK, REDONDO BEACH, CALIFORNIA 90278

FOREWORD

The degree to which a military system is essentially free of hazards, both real and potential, is directly dependent upon management emphasis. This emphasis on failure modes and the severity and ultimate consequences of failures should commence with the initial design concept and continue through development and eventual system operation. Only by clearly stating the specific objectives and requirements can the desired results of the system safety effort be obtained. Attainment of the desired results is further dependent upon the Government and its contractor's ability to translate these objectives and requirements into safe, reliable, economical, and functional hardware.

CONTENTS

1. INTRODUCTION

The Army is developing a Chemical Agent/Munitions Disposal System (CAMDS) for complete demilitarization and disposal of lethal chemical agents and munitions within the constraints of total containment of hazardous materials, impeccable safety to operating personnel and the civilian population, and stringent environmental control standards. The munition systems to be demilitarized include artillery projectiles with and without explosive bursters, chemical rockets with explosives and propellant, chemical mortars and land mines with explosives, bombs, ton containers, and spray tanks. The CAMDS is intended to disassemble the munitions, destroy the explosive components, destroy or neutralize the lethal agents by themal or chemical processes, and decontaminate all residual hardware and inert components. The system is to embody absolute safety precautions to prevent release of the chemical agents to the environment and to protect operating personnel.

The CAMDS consists of specialized, remote-controlled machinery for removing explosive components and chemical agents from munitions, two continuous furnace systems for thermal deactivation of energetic materials and decontamination of metal parts, a chemical agent destruction plant, material transport systems, and the required support systems. The CAMDS is being designed, fabricated, and installed on a modular basis by Edgewood Arsenal, Tooele Army Depot, and their contractors. The plant is scheduled to be operational by 1 October 1976 at the South Area of Tooele Army Depot. The plant will be operated by Government personnel.

This report is a CDRL item prepared under a "Reliability and Maintenance Program Analysis" contract awarded to TRW. AEO Specification No. 75-10, Contract Description/Specifications has served as the baseline for this document. The effort involved is the conduct of a systems Failure Mode and Effects Analysis (FMEA) of the CAMDS based on design data and anticipated operating procedures provided by the Government. Hazards analyses already developed for a few of the CAMDS building blocks have been considered in this document. The scope of work performed has been accomplished with the emphasis on potential hazards and failure modes that could conceivably result in an impact on the environment and/or

compromise the health and safety of personnel and the civilian population, rather than the possible maintenance and repairs as a result of failures affecting normal plant operation.

Section 2 provides a summary of the CAMDS building blocks, the munitions to be demilitarized, and the agents employed in these munitions. Section 3 shows the rationale and methodology employed in conduct of the analysis. Section 4 consists of the FMEA charts along with pertinent logic diagrams. The summary and conclusions are presented in Section 5 and include consideration of three significant aspects: environment, safety, and facility operations.

Acknowledgement for their contributions toward preparation of this report is made to Armond Kaloust, E. J. Gearhart, R. A. Paulson, J. Sings and R. Armstrong.

2. CAMDS DESCRIPTION

2.1 GENERAL

The CAMDS site is located at the South Area of Tooele Army Depot Tooele, Utah. All personnel entering the CAMDS facility on foot must go through the Personnel Support Complex (PSC). A 20-foot-wide road provides vehicle access around the perimeter of the CAMDS site. A rail line with a tank car unloading station is located just outside the fenced area. Chemicals are pumped from this unloading station to a bulk chemical storage tank area located inside the fenced area adjacent to the Agent Destruction System (ADS).

All munitions, with the exception of bulk items, will be brought into the fenced area and placed behind a massive barricade identified as the Munition Holding Area (MHA). The munitions stored temporarily in this area are transported to the Unpack Area (UPA) as required for processing.

2.2 BUILDING BLOCK DESCRIPTION

For the purpose of technical and financial management of the program the CAMDS has been subdivided into a number of building blocks. These building blocks include processing subsystems and system integration functions. Those which were considered in the FMEA are listed and briefly described as follows:

01 - UPA - Unpack Area
02 - ECC - Explosive Containment Cubicle
04 - DFS - Deactivation Furnace System
05 - MPF - Metal Parts Furnace
06 - RDM - Rocket Demil Machine
07 - DUN - Dunnage Incinerator System
08 - UTL - Utilities
09 - EHM - ECC Hydraulics
10 - CON - Control Module
12 - PSC - Personnel Support Complex
13 - ADS - Agent Destruction System
14 - ETS - Explosive Treatment System
15 - PDM - Projectile Demil Machine

18 - PPD - Projectile Pull and Drain Machine
19 - CDS - Central Decon System
20 - PDF - Projectile Disassembly Facility
21 - BIF - Bulk Item Facility
22 - MHE - Material Handling Equipment
23 - FIL - Filter System
24 - MOR - Motar Demil Machine
25 - MIN - Mine Demil Machine
26 - PIP - Piping
27 - ELE - Electrical
28 - MOD - Scale Model
29 - PER - Perimeter Monitoring
30 - CTV - Closed Circuit Television
31 - COM - Communications
32 - CML - Chemical Laboratory
33 - DET - Detectors
34 - TDP - Techincal Data Package
35 - SCS - Site Control System
36 - TNG - Training
37 - RAM - Repair and Maintenance
38 - SMP - System Management and Planning
39 - OES - Operational Engineering Support
40 - SIT - Initial Test and Site Development
41 - SYS - System Integration

01-UPA-Unpack Area. The purpose of the UPA is to provide an area within the CAMDS where the items to be processed in the ECC and PPD can be reinspected, removed from their shipping and storage containers, and prepared for the demilitarization process. The UPA consists of two areas: the unpack operating area and the airlock area. The housing is physically connected to the ECC housing and faces the Personnel Support Complex (PSC).

02-ECC-Explosive Containment Cubicle. The ECC's primary purpose is to retain the fragments and chemical agents that would result from an explosive incident during demilitarization of chemical munitions. All munitions that contain explosive components will be processed through

the ECC to remove the explosive components and cut the explosive into segments small enough to process through the Deactivation Furnace System (DFS). The chemical agent will be drained from rockets and mines in the ECC.

Four separate machines are designed for installation in the ECC one at a time, dependent on the type of munition to be demilitarized. They are the Rocket Demil Machine (RDM), the Projectile Demil Machine (PDM), the Mortar Demil Machine (MOR) and the Mine Demil Machine (MIN). A conveyor especially designed for each machine connects the unpack area with the machine in the ECC. The ECC discharge conveyor for each machine is located in the ECC housing between the ECC and the DFS.

04-DFS-Deactivation Furnace System. The DFS comprises that area of the CAMDS where propellant and explosives are thermally destroyed. Inert materials (metal and glass) processed along with these explosives and propellants are thermally detoxified of agent.

The major components of the DFS are: an air/blast lock, an oil-fired rotary retort, a shrouded electrically heated discharge conveyor, and an air pollution control system. The air pollution control system is comprised of: a cyclone collector, a slagging afterburner, a variable throat venturi scrubber, a quench tower, a packed bed scrubber, a demister, an air exhaust fan, and a stack.

05-MPF-Metal Parts Furnace. The purpose of the Metal Parts Furnace (MPF) is to thermally destroy residual GB and VX agent contamination on munition components without explosives and to thermally detoxify filled ton containers of H, HD and HT, and munitions without explosives. The MPF system consists of the following major areas: punch chamber, vaporization chamber, burnout chamber, 2 afterburners and APC system.

06-RDM-Rocket Demil Machine. The basic purpose of the RDM is to provide a safe means of remotely separating the bulk of the agent from the M55 rocket and to dissect the rocket into sections small enough to be handled by the DFS. The RDM is installed in the ECC.

07-DUN-Dunnage Incinerator. The main purpose of this incinerator is to destroy uncontaminated dunnage consisting of wooden pallets and combustible packing materials which would otherwise accumulate in the

Unpack Area (UPA). The system is designed to handle an average rate of 500 lb/hr.

08-UTL-Utilities. The UTL will provide for steam, water, septic, compressed air, hydraulic pressure and air-conditioning needs in the CAMDS site.

Process steam is required for the Metal Parts Furnace and Agent Destruction System and the steam will also heat the CAMDS site in the winter. A water distribution system provides for all site needs for fire protection, process and potable water. Compressed air is available to support operations in the UPA, ECC, PDF and BIF. Hydraulic pressure is provided to support equipment in the UPA, ECC, PDF, BIF and ADS.

09-EHM-ECC Hydraulics. The ECC Hydraulic System supplies the hydraulic fluid at the required flow rates and pressure for the ECC, the equipment that is installed in the ECC, and for the ECC input and output conveyors. A similar system is installed in the PDF to supply hydraulic power for the PPD and the BIF.

10-CON-Control Module. The basic purpose of the CON is to provide a building to house operators, control panels, computers, and closed circuit TV monitors for those CAMDS operations which will be automated.

12-PSC-Personnel Support Complex. The PSC is an assembly of portable modules serving as the facility for the issue and storage of protective clothing and coveralls, disposal of dirty clothing, change and storage of clothes, toilet requirements, eating facilities, and personnel showers. The protective clothing storage/change module is connected to a filter/ventilation system and a hot-waste collection system.

13-ADS-Agent Destruction System. The ADS is that area of the CAMDS designed for bulk detoxification of agents GB and VX with only one agent being processed at any time, and will also process plant waste containing GB, VX and mustard.

All agent processing will be performed in "toxic" areas, while the remainder of the ADS housing will contain the brine bulk reduction (drying) and utility units. The processing of chemical agents GB and

VX within the ADS is referred to as detoxification and the toxic process module includes all necessary process equipment such as process scrubbers, pumps, heat exchanges, reactors, and agitators as well as "holding" tanks. A bulk reduction area provides for the automatic and continuous processing of the detoxified liquor and contains all equipment necessary to reduce the detoxified liquor to a dry product or sludge which will not produce either a hazard or nuisance from dust, solid fumes, or corrosion.

14-ETS-Explosive Treatment System. The ETS is the area of the CAMDS where sludge and dissolved explosives from spent decontamination solution from the ECC are removed. The filtered spent decon is then pumped to the ADS for final disposal. The ETS is comprised of bag-type filter units, charcoal absorption columns, tanks, pumps, piping, and the necessary controls.

15-PDM-Projectile Demil Machine. All burstered and/or fused projectiles will be processed in the PDM. The machine is installed in the ECC and will receive the munitions via the UPA on ECC Input Conveyor. Once inside the ECC, the PDM will saw the nose closure or fuze from the projectile to expose the burster or supplementary charge for removal by the appropriate removal device. Projectiles that have had their energetic materials removed will undergo further processing in the PPD machine. (See Building Block 18).

18-PPD-Projectile Pull and Drain Machine. The basic function of the PPD is to remove the nose closure from non-burstered projectiles, pull the burster well, and remove VX and GB agents from projectiles. The PPD is located in the Projectile Disassembly Facility (PDF) and is contained within an interior housing. The PPD includes the following stations: PPD load station, nose closure removal station, burster well weld cutting station, burster well pull station, drain station, and PPD unload station.

19-CDS-Central Decon System. The CDS mixes, stores, and supplies calcium hypochlorite decon solution to all areas of the CAMDS for VX and mustard operations. The CDS also stores sodium hydroxide decon solution prepared in the ADS for supply, on demand, to the PPD, BIF and MPF. The CDS occupies a chamber in the PDF and includes as major

components: a decon supply tank, a vacuum conveyor used to transfer hypochlorite powder from shipping drums to the supply tank, two holding tanks, and ancillary control and monitoring equipment.

20-PDF-Projectile Disassembly Facility. The purpose of the PDF is to provide a facility to house the Projectile Pull and Drain Machine, (PPD), Central Decon System (CDS), and the Bulk Item Facility (BIF). There will be no explosives in this area. Sump drains are installed for the BIF shower, the drain station in the BIF, the BIF holding area, the BIF airlock, the PPD shroud, and the PPD.

21-BIF-Bulk Item Facility. The BIF is the area of CAMDS designated for demilitarization of large nerve agent-filled munitions and bulk containers and will process agents GB and VX. The Facility housing incorporates a toxic drain area, agent area, a control room, and an enclosed holding/preparation area. The BIF includes material handling equipment to off-load the bulk items into the holding/preparation area, transport the items into and out of the drain bays, and deliver the items to the input conveyor of the MPF.

22-MHE-Material Handling Equipment. The MHE is utilized in the CAMDS to provide conveyors for the transfer of munitions and munition components to various locations inside the toxic areas. All munitions except bulk items will be processed by the material handling equipment.

23-FIL-Filter System. The filter/ventilation system will assure that exhaust air (minimum of 25 changes per hour) from normally contaminated areas is filtered for agent removal prior to release to the atmosphere. In addition, the system will exhaust (minimum of six changes per hour) from areas where occasional or trace contamination might occur.

24-MOR-Mortar Demil Machine. The purpose of the MOR is to remove the M8 fuse and M14 burster from the 4.2-inch mortar. The mortar machine is located inside the ECC and is remotely operated by the computer control system. The mortar machine will remove the fuse and burster, then will transfer both items by conveyor to the deactivation furnace for destruction. The mortar round will be conveyed to the PPD for further processing.

25-MIN-Mine Demil Machine. The mine machine is designed to remove and separate the M120 booster and the M38 burster, and then drain the agent cavity prior to sending the mine to the Deactivation Furnace (DFS). The M23, VX land mine will be processed in this machine, which is installed in the ECC.

26-PIP-Piping. The CAMDS piping system transfers or routes air, steam, and process liquids within the site. Detectors are installed on the outer double pipe to sense if any agent is leaking during the transport of GB and VX.

27-ELE-Electrical. The primary purpose of the electrical distribution system is to supply and distribute commercial and emergency standby power throughout the CAMDS site. The CAMDS site contains four power transformers: a 75-kva, 208-volt unit for the well pump, a 300-kva, 208-volt unit for the PSC, a 750-kva, 208-volt unit for the CAMDS demil equipment, and a 1500-kva, 480-volt unit also for the CAMDS demil equipment.

The site also has three diesel engine driven emergency standby generator sets to supply power to critical areas in case of a commercial power failure. One 500-kw unit supplies 480-volts and two 235-kw units supply 208 volts.

28-MOD-Scale Model. Not Applicable.

29-PER-Perimeter Monitoring. The perimeter monitoring network will sample the ambient air quality at points around the CAMDS site to determine the background concentration of varous pollutants and demonstrate that no ill effects result from CAMDS operations. The perimeter monitoring network will incorporate eight stations along a perimeter about 2 miles from the site, with each station operating continuously.

30-CTV-Closed Circuit Television. These surveillance systems provide for remote observation of machines, conveyors, and maintenance operations in toxic areas.

31-COM-Communications. The CAMDS "COM" system provides direct communication between all control stations and housings on the CAMDS site; e.g., supervisory personnel at control stations can communicate with maintenance personnel wearing level A protective clothing in contaminated areas.

32-CML-Chemical Laboratory. The CAMDS Chemical Laboratory will provide all the analytical support required for the demilitarization of toxic chemical agents. The primary areas requiring such support will be the Perimeter Monitoring Networks (PER), Detectors, and the ADS, MPF, and DFS.

33-DET-Detectors. The detectors will monitor the CAMDS site for the presence of agents to protect plant operators and the surrounding populace, as well as to monitor the plant processes. These detectors have the capability to detect any agent processed by CAMDS.

34-TDP-Technical Data Package. Not Applicable.

35-SCS-Site Control System. This system exercises master control and monitoring over the CAMDS site.

36-TNG-Training. Not Applicable.

37-RAM-Repair and Maintenance. Not Applicable.

38-SMP-System Management and Planning. Not Applicable.

39-OES-Other EA Support. Not Applicable.

40-SIT-Initial Test and Site Development. Not Applicable.

41-SYS-System Integration. Not Applicable.

2.3 DEMIL SYSTEM APPLICATION

The building blocks are arranged to provide for demilitarization of each of seven general munition configurations, plus bulk items. These configurations, which will be processed at the CAMDS at Tooele, Utah, are listed with their respective agents in Table 2-1.

Figure 2-1 is a composite of munitions inventory, line designations and respective building block application, pinpointing munition/building block demilitarization hardware requirements.

Table 2-1. Munition Configurations

Configuration No.	Munition Type	Agent	Explosive
1	M55 Rocket	GB,VX	3.2-lb Composition B
2	M23 Mine	VX	0.8-lb Composition B
3	105-mm M360, Burstered	GB	1.1-lb Tetrytol
4	105-mm M360, Non-Burstered	GB	None
5	155-mm M110	H	0.41-lb Tetrytol
	155-mm M104	HD	0.41-lb Tetrytol
6	155-mm M121	GB	None
	155-mm M121A1	GB,VX	None
	155-mm M122	GB	None
	8-inch MA26	GB	None
7	4.2-inch Mortar	HD,HT	0.14-lb Tetryl

CAMDS BUILDING BLOCKS

MUNITIONS INVENTORY

	PRESENT ABV.	PRIME RESPONSIBILITY	BUILDING BLOCK	MUNITIONS DESIGNATION / DIMENSIONS, WEIGHT	AGENT TYPE	AGENT WT	EXPLOSIVE TYPE	EXPLOSIVE WT	PROPELLANT TYPE	PROPELLANT WT, FUSE
1.	UPA	TEAD	UNPACK AREA	Rocket, 115mm, M55	GB	10.7#	Comp B	3.2#	M28	19.3#, M417
2.	ECC	TEAD	EXPLOSIVE CONTAINMENT CUBICLE	78.0"x115mm, M55	VX	10.0	Comp B	3.2#	M28	19.3#, M417
4.	DFS	EA	DEACTIVATION FURNACE SYSTEM	Rocket, 115mm, 57#	GB	1.6#	None		None	
5.	MPF	EA	METAL PARTS FURNACE	78.0"x115mm, M55	GB	6.5#	None		None	
6.	RDM	TEAD	ROCKET DEMIL MACHINE	Cartridge, 105mm, 56#	GB	6.5#	None		None	
7.	DUN	EA	DUNNAGE INCINERATOR SYSTEM	31.1"x105mm, M360	GB	6.5#	None		None	
8.	UTL	TEAD	UTILITIES	Projectile, 105mm, 44#	VX	14.5#	None		None	
9.	EHM	TEAD	ECC HYDRAULICS	26.7"x155mm, M121A1	GB	6.0#	None		None	
10.	CON	TEAD	CONTROL MODULE	Projectile, 155mm, 100#	GB	1.6#	Tetryl	1.1#	None	
12.	PSC	EA	PERSONNEL SUPPORT COMPLEX	26.7"x155mm, M121	H	11.7#	TNT	11.7#	M1	2.5#
13.	ADS	EA	AGENT DESTRUCTION SYSTEM	Projectile, 155mm, 100#						
14.	ETS	EA	EXPLOSIVE TREATMENT SYSTEM	35.1"x8", 199#						
15.	PDM	TEAD	PROJECTILE DEMIL MACHINE	Projectile, 8", M426						
18.	PPD	TEAD	PROJECTILE PULL AND DRAIN MACHINE	26.7"x155mm, M121A1						
19.	CDS	EA	CENTRAL DECON SYSTEM	Cartridge, 105mm, 100#						
20.	PDF	TEAD	PROJECTILE DISASSEMBLY FACILITY	31.1"x105mm, M360						
21.	BIF	EA	BULK ITEM FACILITY	Projectile, 105mm, 44#						
22.	MHE	TEAD	MATERIAL HANDLING EQUIPMENT	26.8"x155mm, M110						
23.	FIL	EA	FILTER SYSTEM	Projectile, 155mm, 95#						
24.	MOR	TEAD	MORTAR DEMIL MACHINE	Mine, 2 gallon, M23						
25.	MIN	TEAD	MINE DEMIL MACHINE	5.0"x13.5", 23#						
26.	PIP	TEAD	PIPING	Cartridge, 4.2", 23#						
27.	ELE	TEAD	ELECTRICAL	21"x4.2", Mortar						
28.	MOD	EA	SCALE MODEL	Cartridge, 4.2", 25#						
29.	PER	EA	PERIMETER MONITORING	21"						
30.	CTV	TEAD	CLOSED CIRCUIT TELEVISION							
31.	COM	TEAD	COMMUNICATIONS							
32.	CML	EA	CHEMICAL LABORATORY							
33.	DET	EA	DETECTORS							
34.	TDP	PMO	TECHNICAL DATA PACKAGE							
35.	SCS	TEAD	SITE CONTROL SYSTEM							
36.	TNG		TRAINING							
37.	RAM		REPAIR & MAINTENANCE							
38.	SMP		SYSTEM MANAGEMENT AND PLANNING							
39.	OES		OTHER EA SUPPORT							
40.	SIT		INITIAL TEST & SITE DEVELOPMENT							
41.	SYS		SYSTEM INTEGRATION							

MUNITIONS DEMILITARIZATION LINE DESIGNATIONS

	FC #1 M 55 ROCKET GB/VX	FC #2 PROJECTILES/CARTRIDGES GB/VX WITHOUT BURSTERS	FC #3 P/C GB/VX WITH BURSTER	FC #4 PROJECT MUSTARD WITH BURSTER	FC#5 M23 MINE VX	FC #6 4.2" MORTAR MUSTAR
1. UPA	H	H	H	H	H	H
2. ECC	H		H	H	H	H
4. DFS	H		H	H	H	H
5. MPF		H	H	H		H
6. RDM	H					
7. DUN	H	H			H	H
8. UTL	H	H	H	H	H	H
9. EHM	H	*	H	H	H	H
10. CON	H	H	H	H	H	H
12. PSC						
13. ADS	H	H	H	H	H	H
14. ETS	H		H	H	H	
15. PDM			H	H		
18. PPD		H	H	H		H
19. CDS	H	H	H		H	
20. PDF		H	H	H		H
21. BIF						
22. MHE	H	H	H	H	H	H
23. FIL	H	H	H	H	H	H
24. MOR						H
25. MIN					H	
26. PIP	H	H	H	H	H	H
27. ELE	H	H	H	H	H	H
28. MOD						
29. PER	H	H	H	H	H	H
30. CTV	H	H	H	H	H	H
31. COM	H	H	H	H	H	H
32. CML	H	H	H	H	H	H
33. DET	H	H	H	H	H	H
34. TDP						
35. SCS	H	H	H	H	H	H
36. TNG						
37. RAM						
38. SMP						
39. OES						
40. SIT						
41. SYS						

2

Item	Agent / weight	Burster	Fuze / other
[Pro]jectile, M360; 26.8"x[...], 44#	14.5#	None	None
Projectile, 155mm, M110; 26.8"x155mm, 99#	VX 6.0#	None	None
Projectile, 155mm, M104; 26.8"x155mm, 95#	GB 1.6#	None	None
Mine, 2 gallon, M23; 5.0"x13.5", 23#	H 11.7#	None	None
Cartridge, Mortar, M23; 21"x4.2", 25#	HD 11.7#	Tetrytol 1.1#	None
Cartridge, Mortar, 4.2", M2/M2A1; 21"x4.2", 25#	VX 10.5#	Tetrytol 0.41#	M1
Cartridge, Mortar, 4.2", M2/M2A1; 21"x4.2", 25#	HD 6.0#	Tetrytol 0.41#	2.75# M508
Bomb, 750#, MC-1; 50.0"x16", 725#	HT 5.8#	Comp B 0.8#	None
Tank, Spray, TMU-28/B; 185.0"x22.5", 1935#	GB 220.0#	Tetryl 0.14#	None
Ton Container; 81.5"x30.1", 2900#	VX 1356.0#	Tetryl 0.14#	None M603
Ton Container; 81.5"x30.1", 3000#	GB 1500.0#	None	M6
Ton Container; 81.5"x30.1", 3100#	VX 1600.0#	None	0.4#MB
	HD 1700.0#	None	M6
		None	0.44 M51A5
		None	None
		None	None
		None	None
		None	None
		None	None

FC #3	FC #4	FC#5	FC #6	FC #7	FC #8	NOTES:
H	—	H	H			
H	—	H	H			
H	—	H	H			
H	—		H	H	H	Machine is installed in the ECC to process the indicated munitions.
		H	H			
H	—	H	H	H	H	
H	—	H	H	*	*	*A similar system is contained in the PDF to operate the PPD and BIF.
H	—	H	H	H	H	Facility only,see BB #35 for hardware.
H	—	H	H	H	H	
H	—	H				
H	—					Machine is installed in the ECC to process the indicated munitions.
H	—		H			Machine is housed in the PDF.
		H		H		Hardware is housed in the PDF.
H	—		H			Contains the PPD, CDS, and BIF.
				H		Hardware is housed in the PDF.
H	—	H	H	H	H	There are many independent conveyors servicing the Building Blocks.
H	—	H	H	H	H	There are 11 independent CAMDS filter systems servicing the Building Blocks.
			H			Machine is installed in the ECC to process the indicated munitions.
		H				Machine is installed in the ECC to process the indicated munitions.
H	—	H	H	H	H	
H	—	H	H	H	H	
H	—	H	H	H	H	Safety could shutdown the CAMDS if perimeter monitoring fails. Checked every 12 hrs.
H	—	H	H	H	H	
H	—	H	H	H	H	
H	—	H	H	H	H	There are 3 backup units for critical tests in the CML.
H	—	H	H	H	H	Stack Detectors, Area Detectors Process Level Detectors.
H	—	H	H	H	H	Includes Computer Control System (CCS) See BB #10.

[FC #]3	FC #4	FC#5	FC #6	FC #7	FC #8
[...]X [...]TER	PROJECT MUSTARD WITH BURSTER	M23 MINE VX	4.2" MORTAR MUSTARD	BULK ITEMS GB/VX	TON CONTAINER MUSTARD

COMMENTS:

SUCCESSFUL OPERATION
A GIVEN MUNITIONS COL[...]
MUNITIONS DEMILITARIZA[...]
WILL REQUIRE THAT DEMI[...]
PROCESSED BE HALTED.
MUNITIONS TYPES TO BE
OTHER MUNITION TYPES.
TION OPERATIONS CEASE
INPUT CONVEYOR DURING
TIONS ON THAT MUNITIO[...]
THE FOLLOWING DEMILITA[...]

- o PROJECTILES/CARTR[...] GB/VX WITH BURSTE[...]
- o PROJECTILES MUSTA[...] WITH BURSTERS
- o M23 MINE VX
- o 4.2-INCH MORTAR M[...]

DEMILITARIZATION OF
COULD BE STARTED:

- o BULK ITEMS GB/VX
- o TON CONTAINER MUSTARD

ANY FAILURE RESULTI[...]
UNACCEPTABLE AGENT [...]
OF THE MUNITIONS UN[...]

3

he indicated munitions.
perate the PPD and BIF.
e indicated munitions.
g the Building Blocks.
servicing the Building Blocks.
e indicated munitions.
e indicated munitions.
nitoring fails. Checked every 12 hrs.
the CML.
Detectors.
910.

COMMENTS:

SUCCESSFUL OPERATION OF THE BUILDING BLOCK HARDWARE INDICATED BY "H" IN A GIVEN MUNITIONS COLUMN IS NECESSARY FOR SUCCESSFUL OPERATION OF THAT MUNITIONS DEMILITARIZATION LINE. MANY FAILURES WITHIN A BUILDING BLOCK WILL REQUIRE THAT DEMILITARIZATION OPERATIONS ON THE MUNITIONS TYPE BEING PROCESSED BE HALTED. MANY OF THESE FAILURES WILL NOT ALLOW CERTAIN MUNITIONS TYPES TO BE DEMILITARIZED BUT WILL ALLOW DEMILITARIZATION OF OTHER MUNITION TYPES. CERTAIN FAILURES WILL REQUIRE THAT ALL DEMILITARIZATION OPERATIONS CEASE (I.E., INOPERATIVE FAILURE OF THE UNPACK AREA'S ECC INPUT CONVEYOR DURING DEMILITARIZATION OF M55 ROCKETS WOULD HALT OPERATIONS ON THAT MUNITION AND WOULD NOT ALLOW DEMILITARIZATION OF MUNITIONS VIA THE FOLLOWING DEMILITARIZATION LINES EITHER:

- PROJECTILES/CARTRIDGES GB/VX WITH BURSTERS
- PROJECTILES MUSTARD WITH BURSTERS
- M23 MINE VX
- 4.2-INCH MORTAR MUSTARD

DEMILITARIZATION OF MUNITIONS VIA THE FOLLOWING DEMILITARIZATION LINES COULD BE STARTED:

- BULK ITEMS GB/VX
- TON CONTAINER MUSTARD

ANY FAILURE RESULTING IN AN UNPACK AREA AGENT DETECTOR REGISTERING AN UNACCEPTABLE AGENT LEVEL WOULD NOT ALLOW THE DEMILITARIZATION OF ANY OF THE MUNITIONS UNTIL AFTER CLEAN-UP.

Figure 2-1. Munition Demilitarization Hardware Requirements

3. ANALYSES

This section describes the procedures employed in conduct of the FMEA. It includes a list of source material employed, definitions of terms used, and describes the rationale and methodology. Section 4 provides the logic flow diagrams and FMEA charts generated.

3.1 DEFINITION OF TERMS

For the purposes of this report in both text and data presentation herein, the following term definitions will apply:

- Building Block - A functional major subsystem which has a specific purpose in the system and is composed of a number of interfacing modules and components.
- Component - A combination of parts, usually self-contained, which performs a particular function (or more than one function) and is usually at the replaceable item level.
- Criticality Index - A quantitative assessment of the relative importance of a failure mode obtained by combining the assigned severity level with the expected or known frequency of failure.
- Failure - The inability of a part, component assembly, etc., to perform its required function within specified limits.
- Failure Analysis - The logical, systematic examination of an item to identify and analyze the cause and mode of failure of the item.
- Failure Mode - The manner in which a hardware item fails.
- Failure Mode Effects Analysis (FMEA) - A technique for system design evaluation which lists elements of that design, determines the effects of modes on system/elements, and documents built-in deterrence or corrective action necessary.
- Failure Rate - The number of failures of an item per unit measure of life in cycles, time, or events as applicable.

For purposes of establishing criticality indexes, failure rates will be qualitatively identified at four levels:

- Level 1, negligible failure probability
- Level 2, low failure probability
- Level 3, 50 percent chance of occurrence during its mission operation
- Level 4, high probability of occurrence during its mission operation.

- Hazard Level - A qualitative measure of hazards stated in relative terms. The following definitions of hazards levels are in consonance with applicable MIL Specifications:

  Category I - Negligible. Conditions such that personnel error, environment, design characteristics, procedural deficiencies, or subsystem or component failure or malfunction will not result in personnel injury or system damage.

  Category II - Marginal. Conditions such that personnel error, environment, design characteristics, procedural deficiencies or subsystem or component failure or malfunction can be counteracted or controlled without injury to personnel or major system damage.

  Category III - Critical. Conditions such that personnel error, environment, design characteristics, procedural deficiencies or subsystem or component failure or malfunction will cause personnel injury or major system damage, or will require immediate corrective action for personnel or system survival.

  Category IV - Catastrophic. Conditions such that personnel error, environment, design characteristics, procedural deficiencies or subsystem or component failure or malfunction will cause death or severe injury to personnel, or system loss.

- Human Engineering - The area of human factors which applies scientific knowledge to the design of items to achieve effective man-machine integration and utilization.

- Inherent - Achievable under ideal conditions, generally derived by analysis and potentially present in the design.

- Item - Used herein to denote the lowest level of hardware assembly as a component or part.

- Mission - The objective of task which with the purpose clearly indicates the action to be taken.

- Module - An assembly of components generally at the replacement level.

- Operational - Pertaining to the state of actual usage.

- Redundancy - The existence of more than one means for accomplishing a given function.

- Reliability - The probability that an item subassembly, assembly, or system will perform its intended function for a specified interval under stated conditions.

- Safety - The conservation of human life and its effectiveness and the prevention of damage to equipments consistent with mission requirements.

- System - The functional total of all building blocks required to accomplish a process and representable by a process logic diagram.

3.2 DOCUMENTS REVIEWED

In addition to technical discussions with key engineering and supervisory personnel at both Edgewood Arsenal and Tooele Army Depot, a relatively large number of drawings, test reports, design criteria, and related U.S. Army documents were reviewed by the contractors in preparation for a support of this report. The source of information for the data presented herein is as follows:

MIL-STD-785A	Reliability Program for Systems and Equipment Development and Production
MIL-STD-721B	Definitions of Effectiveness Terms for Reliability, ...
MIL-STD-470	Maintainability Program Requirements
MIL-STD-882	Requirements for Systems Safety Programs
MIL-STD-1472A	Human Engineering Design Criteria for Military Systems ...
AR 702-3	Army Material Reliability Availability and Maintainability
MIL-STD-280A	Definitions of Item Levels Exchangeability Models and Related Terms
AMCP 702-3	Reliability Handbook
FARADA	Failure Rate Data Handbook - Navy FMSAEG
RADC-TR-68-14	Nonelectronic Reliability Handbook, RADC, N.Y.
AR 385 Series	Army Safety Requirements
AMCR 385-100	Army Safety Manual
Project Eagle (August 1974)	Supplement B - Demilitarization and Disposal of the M35 GB Cluster at Rocky Mountain Arsenal
CAMDS (D.L. Pugh)	Overall Test Program Resume
Edgewood Arsenal (NTIS)	Environmental Statement, Demilitarization of Toxic Munitions at U.S. Army Materiel

PMO (Aberdeen) 28 May 1975	Chemical Munition Stockpile Inspection Conducted in Support of the Chemical Agent Munition Disposal System (CAMDS)
EA & TEAD (April 1975)	Design Criteria, CAMDS
Hercules, Inc.	Preliminary Hazards Analysis of a Metal Parts Furnace and Air Pollution Control System
Hercules, Inc.	Failure Mode and Hazardous Effects Analysis of a Metal Parts Furnace and Air Pollution Control System
PMO (TEAD) (Maj. Timpf)	Enclosure 17, Surveillance and Movement of Munitions, to Draft Demilitarization Plan, July 1975
The Marquardt Co.	Engineering Evaluation of the CAMDS Munitions Demil Machinery Design 01 Vol I, 1974
The Marquardt Co.	Engineering Evaluation of the CAMDS Munitions Demil Machinery Design, 01, Vol II, 1974
PMO - TEAD (28 May 1975)	Chemical Munition Stockpile Inspection - Support of CAMDS
TEAD	Enclosure 5, Explosive Containment Cubicle Testing and Related Data, to Draft Demil Plan for CAMDS, July 1975
TEAD	CAMDS Test Reports - various series, 1972-75
TEAD	CAMDS Drawings - Aperture Cards, as available
Hercules Inc.	Preliminary Hazards Analysis of a Deactivation Furnace and Air Pollution Control System
Hercules, Inc.	Failure Mode and Hazardous Effect Analysis of Deactivation Furnace and Air Pollution Control System
Hercules, Inc.	Failure Mode and Hazardous Effect Analysis of the Agent Destruction System for CAMDS.

3.3 GENERAL APPROACH

Data in the form of drawings, reports, manufacturer's specifications, coupled with discussions with engineering personnel representing both Edgewood Arsenal and Tooele Army Depot, have served as the basis for indoctrination and familiarization with each of the 37 building blocks which

comprise the CAMDS facility. In many instances the building blocks had progressed in fabrication, assembly, and construction to warrant on the spot evaluation. Test data were available in many cases, and actual tests were witnessed on occasion. The CAMDS Overall Test Program Resume, Revision No. 2, dated 12 February 1975, was also made available, along with the document entitled, "Design Criteria for CAMDS," dated April 1975.

The Army furnished a list of all building blocks, along with the cognizant engineer from each major area of responsibility: AEO, EA, TEAD, and PMO. The assignment of personnel from the aforementioned areas to each of the CAMDS building blocks provided an excellent opportunity to obtain design and operational information with which to evaluate potential hazards and conduct FMEAs. Additionally, analyses conducted by contractors and/or suppliers were incorporated in this document.

Of the 37 building blocks which comprise the CAMDS facility currently under construction at Tooele, Utah, nine were isolated as being exempt from the intent and purposes of this effort. The nine building blocks which are considered exempt are as follows:

No. 38 - MOD (Scale Model)
No. 33 - DET (Detectors)
No. 34 - TDP (Technical Data Package)
No. 36 - TNG (Training)
No. 37 - RAM (Repair and Maintenance)
No. 38 - SMP (System Management and Planning)
No. 39 - OES (Operational Engineering Support)
No. 40 - SIT (Initial Test and Site Development)
No. 41 - SYS (System Integration)

The remaining 28 building blocks were evaluated with particular emphasis on identification of hazards and high probability failure modes that could be considered catastrophic or critical. The results of these analyses could then be utilized to support the Army's Environmental Impact Statement (EIS) that must be prepared prior to actual operation of CAMDS at Tooele.

3.4 RATIONALE

Reliability predictions are "before the fact," while "assessments" are statistical in nature because of the availability of actual data.

To conduct FMEAs by evaluating design, configuration, processes and procedures "before the fact" requires establishment of specific assumptions. These assumptions are, of necessity, qualitative in nature, because of the absence of specific data. In many cases "similarity" will suffice.

In order that the FMEAs and Hazards Evaluation of CAMDS be consistent and easily understood by the reader it may prove beneficial to provide the rationale employed. The family automobile is a vehicular system which consists of mechanical, electromechanical, electrical, hydraulic, chemical, and other technologies that are employed in CAMDS. There is no attempt made herein to liken an automobile to CAMDS but rather to use the automobile as being analogous to a series of building blocks, modules, and/or subsystems.

Severity levels and failure rate levels can be assigned to the automobile as an integrated vehicle or to any of its subsystems or components. A hazards' evaluation can be ascertained, based on the criticality index of consequences of any given failure.

For example, the likelihood of a flywheel shearing from the crankshaft is obviously very, very low in probability. For lack of a quantitative or assigned numerical value, a level one (1) rating would be assigned. If a data bank existed from the major engine manufacturers, it might well be determined that the likelihood of a flywheel becoming disengaged from the crankshaft is so small as to be considered as one chance in 3 to 5 million. Whether a one (1) is assigned to this probability or a 2.5×10^{-7}, the intent is to identify it as a very low or negligible probability.

However, if the flywheel were to tear loose, it is conceivable that serious injury could occur to the driver or passenger, particularly since the lower legs are in close proximity to the flywheel in the vast majority of automobiles. The flywheel is turning at an undetermined speed and can, via inertia, depart the crankshaft in any one of many directions. A spinning disk may traverse along any of 360 degrees. Further, in order to physically come in contact with the passengers' feet or legs, the flywheel must travel in precisely the right direction, have considerable momentum, and display sufficient energy to tear through an array of steel structure.

We do not, in actual day-to-day driving of our family automobile, assign a high (Category IV) severity level because of the flywheel. Yet, it is absolutely correct to state that a flywheel breaking loose from the engine can bring about catastrophic results. The probability of occurrence (failure rate) is certainly one (1) or less and the severity level could be assigned a four (4). The criticality index, therefore, is (1 x 4) four (4); however, there is no doubt evidence in existence to justify assigning a severity level of three (3), wherein the criticality index would be (1 x 3) three (3).

The fuel pump on the average family automobile can be expected to fail at least once during the "mission" life of the engine This can be considered as a level (3) failure rate since there is a 50 percent chance of occurrence. However, the severity level is no more than a category one (1) hazard, since failure of the fuel pump results in negligible injury to personnel or system damage. Loss of a fuel pump, therefore, results in a criticality index of three (3) also.

Note: An electrical fuel pump can also be installed so that failure of the engine driven pump will automatically cut in the electric fuel pump.

Fan belt breakage is another common occurrence on automobile engines. The frequency of failure or failure rate is established at three (3), while the hazard is negligible, resulting in a criticality index of (3 x 1) three (3).

Similarly, fan belts can be inspected and/or replaced at periodic intervals to preclude or reduce significantly the likelihood of a belt breaking on a motor trip. Redundant pulleys and belts can also be installed to improve reliability of the system.

The aforementioned discussion is presented to explain the rationale employed in the conduct of the FMEA and Hazard Evaluation accomplished in support of CAMDS. The emphasis has been placed on those building blocks, modules and/or components, the failure of which would result in a critical or catastrophic condition.

Upon examination of each of the 28 building blocks to determine where the emphasis of evaluation must be placed for purposes of the FMEA, several

blocks appear dominant. These blocks designated as the preliminary initial building blocks were studied more intently for specific possible contribution to unsafe CAMDS operation. As studies progressed to component evaluation level, the number of the preliminary critical blocks decreased and changed to a final critical building block designation as follows:

Number	Building Block
01	(UPA) Unpack Area
02	(ECC) Explosive Containment Cubicle
04	(DFS) Deactivation Furnace System
05	(MPF) Metal Parts Furnace
13	(ADS) Agent Destruction System
21	(BIF) Bulk Item Facility

Critical blocks were selected on the basis of their present or potential destructive energy source or lethal toxic release possibility. These criteria are not necessarily reflected in the FMEA charts criticality designations due to inherent safety provisions or deterrent provisions or other mitigating factors. Several building blocks (e.g., ECC Hydraulics) were studied in detail before eliminating them from the critical block lists. All detail information was included in the report. Of particular interest was the Explosive Containment Cubicle (ECC) whose implicit operation is one of a high hazard-generating nature, but whose design emphasis was toward avoidance or minimization in specific detail of the identified possible hazards. It is entirely possible that further studies may modify the list of critical building blocks to some degree.

In this evaluation no single point failure that could be classified as a Category IV (catastrophic) situation was found to exist in any building block. The designs, configurations, processes, and procedures (many of which have been validated via tests) were found to incorporate deterrent features to the extent that two or more failures must occur prior to developing catastrophic conditions.

3.5 DATA PRESENTATION

The data gathered for inclusion in this report are presented in Section 4 which follows. To present these data in an organized, understandable, and consistent fashion a standard format was devised which includes all the

important areas of information. This format contains all elements of the one suggested by the Contract Description and Specification Document. Following is a description of the form and the bases for applicable entries.

3.5.1 Building Block Element

This column includes a two-part number composed of the Building Block number and the consecutively numbered item of that Block which is being considered. The Building Block number is taken from the master list of current Building Blocks numbered from 1 to 41 as provided by AEO office at TEAD. Thus, an item numbered 5.2 is the second component assembly or subsystem being considered in the Metal Parts Furnace Block (No. 5).

3.5.2 Component or Item

This entry contains a descriptive title for the item being addressed. Enough description is included in this entry to firmly identify the item.

3.5.3 Function

Herein is listed the purpose or function of the item/component being described with enough descriptive material to enable a direct correlation with the failure mode to be described. *In many cases the function of an* element is fairly well included in its name (i e. filter); however, the specific application, type, or use may not be obvious.

3.5.4 Failure Mode/Cause

The specific failure mode being considered for each item is listed. Emphasis is placed upon those modes which obviously (and also not obviously) present the greater personnel or equipment hazard. However, all failure modes are included in the data sheets, regardless of importance, if they were identified during the evaluation. Failure modes most generally fell into the categories of:

- Failure to operate
- Untimely operation
- Faulty operation
- Failure to cease operation when required.

Causes for considered failures may be wide ranging in scope but are traced only as far as needed to establish suspected primary or primary/ secondary causes. All possible causes are identified where failure

effects appear critical or catastrophic at either the building block or component levels.

3.5.5 Failure Consequences

The effects of each identified failure mode are analyzed and recorded for impact upon either or both personnel and equipments as applicable. Failure consequences to personnel are emphasized where so identified whether catastrophic or not. Effects of failure modes on equipment are traced to higher levels where appreciable impact is expected. Multiple simultaneous or contributory failures are so noted when the consequences are more serious than failure of single components alone. In those cases where a toxic release is an expected consequence, the release environment is noted so that release to, or confinement within, a controlled (air change-filtered) space is not mistaken for release to an outside (uncontrolled) environment.

3.5.6 Failure Deterrence/Corrective Action

This entry notes methods and provisions for obviating or avoiding the specific failure mode(s) which have been incorporated in the system design. These include fail-safe provisions, protective measures, and maintenance activities as applicable. Although consideration of design changes are specifically not a function of this FMEA, recommendations for corrective actions and additions of safeguards are noted where applicable. It will also be noted that many entries in this volume are of considerable length. This is due to inclusion of rationale for choosing the failure mode or cause, failure consequence or deterrent/corrective action, as well as providing the basis for entries in the final three columns of the form. Rationale is included in the entries of this form so that information provided by this form may better "stand on its own" without cumbersome reference to background text for the complete story.

3.5.7 Severity Level

Levels of severity of the identified failure modes are qualitatively established and quantitatively noted. Levels of severity are in general consonance with noted hazards' levels (reference Section 4.1 Definitions) and range through levels 1, 2, 3, 4, parallel in importance to hazards' categories I, II, III, IV, respectively. System and component level analyses are identically rated in this respect.

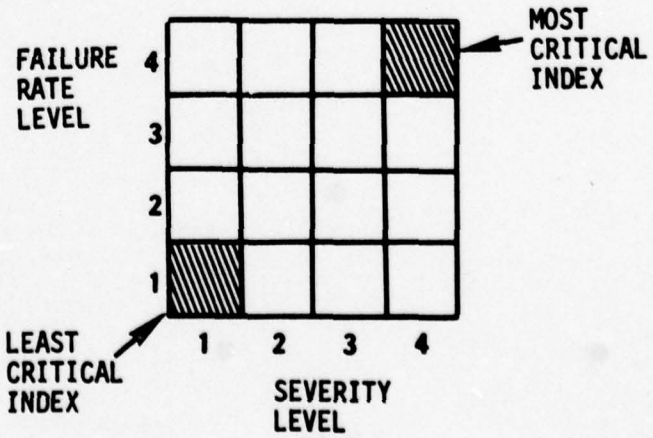
3.5.8 Frequency of Failure

The frequency of failure is a quantitative estimate (failure rate) obtained from analysis of data, actual test data, equipment operational records, data sources such as information elicited from personnel, from government documents, i.e., MIL-HDBK-217A, FARADA, or rates already noted and accepted by TEAD from contractors. For purposes of establishing criticality indexes, failure rates are qualitatively identified at four levels:

- Level 1, negligible failure probability
- Level 2, low failure probability
- Level 3, 50 percent chance of occurrence during its mission operation
- Level 4, high probability of occurrence during its mission operation.

3.5.9 Criticality Index

The criticality index is an orderly indication of the relative criticality of an identified failure resulting from the combination of the severity level and the assigned frequency of failure level. Criticality index is highest when both the severity level and the assigned frequency are highest (4). Conversely, criticality index is lowest and, therefore, not as important in assignment of corrective or deterrent actions, when levels of both severity of failure and frequency levels are 1. All other combinations of these two levels are between these extremes and warrant corrective action attention in accordance with their indexes. The indexes may be combined in a matrix as follows to indicate comparative criticality:



It should be noted that a criticality index is only an indication of the relative importance of the combination of the two preceding columns and cannot therefore stand by itself. That is, an index of 4 may be composed of a failure mode of high severity and low frequency (probability) of occurrence, or vice versa, or of equal severity and frequency of occurrence. General impact of the failure mode will thus be found from the Severity Level column, while processing rate, reliability, or maintainability impact may be referred to from the Frequency of Failure column. A low criticality index number (1, 2) indicates identification of a relatively less important failure mode.

3.5.10 Source Data

Finally, the sources of the data presented in the FMEA formats are identified in the pages immediately following the FMEA forms. Sources are identified with the Building Blocks to which they apply. In addition to the sources of information noted in these pages any of the references listed in Section 4.2, Reference Documents, may also be applicable.

4. DATA - FMEA CHARTS, LOGIC DIAGRAMS

The information presented in this section is comprised of Failure Mode and Effects Analysis Charts, Logic Diagrams, and Information Source data. Arranged by Building Block sequence number, the data cover all building blocks that may contribute to hazardous operations. FMEA charts are constructed as noted and explained in Section 3.5. Logic Diagrams are generally self-explanatory, with diagrams of Building Block facilities arranged by sequence of hardware utilization, and those of Building Block machines by sequence of operations of the machines. Identified failure modes are noted as sub-tiers of hardware or operational blocks and are directly correlated to modes identified on the FMEA charts. The data sources noted represent major sources of information consulted. Other brief conversations have supported and added to this information but are not noted.

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [X]

COMPONENT LEVEL [X]

BUILDING BLOCK: NO. 1. UNPACK AREA (UPA)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
1.0	UNPACK AREA (UPA)	PROVIDES AN AREA WITHIN CAMDS WHERE ITEMS TO BE PROCESSED IN THE ECC AND/OR PPD CAN BE REMOVED FROM THEIR SHIPPING AND STORAGE CONTAINERS AND PREPARED FOR THE DEMILITARIZATION PROCESS. THE UPA ALSO HOUSES THE AIRLOCK WHICH PROVIDES SAFE ENTRY AND EXIT OF THE ECC.						
	PHYSICALLY INTERFACING HARDWARE CONTAINED IN OTHER BUILDING BLOCKS:							
	MATERIAL HANDLING EQUIPMENT (ECC AND ECC BYPASS CONVEYORS).	REFERENCE B/B 22						
	FILTER SSYSTEM	REFERENCE B/B 23						
	LIGHTING SYSTEM	REFERENCE B/B 27						
	DETECTORS	REFERENCE B/B 33						
	PIPING	REFERENCE B/B 26						
	COMMUNICATIONS	REFERENCE B/B 31						
	CLOSED CIRCUIT TV	REFERENCE B/B 30						
	SITE CONTROL SYSTEM	REFERENCE B/B 35						
	CENTRAL DECON SYSTEM	REFERENCE B/B 19						
	UTILITIES	REFERENCE B/B 8						
	ADS	REFERENCE B/B 13						

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐

COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 1. UNPACK AREA (UPA)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
1.1	MOTORIZED OVERHEAD DOOR	PROVIDES ACCESS TO THE UPA FOR A FORKLIFT LOADED WITH A PALLET OF MUNITIONS.	MODE - DOORS BECOME INOPERATIVE IN AN OPEN, CLOSED, OR INTERMEDIATE POSITION. CAUSE(S) A. MOTOR FAILURE (INOPERATIVE) OR MECHANICAL JAMMING.	EQUIPMENT / PERSONNEL IF THE DOOR CANNOT BE OPERATED MANUALLY MUNITION DEMILITARIZATION LINES REQUIRED TO PASS THROUGH THE UPA (ALL THOSE UTILIZING THE ECC AND/OR THE PPD) MUST BE HALTED. (CLOSED: LACK OF MUNITION SUPPLY. OPEN: PROCEDURES REQUIRE THAT THE DOOR BE CLOSED BEFORE THE PROCESSING OF MUNITIONS CAN BEGIN TO MAINTAIN PROPER VENTILIZATION.)	FAILURE DETERRENCE THE MOTOR WILL BE INCLUDED IN THE PERIODIC MAINTENANCE PROGRAM. CORRECTIVE ACTION THE DOOR CAN BE OPERATED MANUALLY ON AN INTERIM BASIS. BULK ITEMS (GB/VX) BOMBS, SPRAY TANKS AND TON CONTAINERS (MUSTARD) MUNITION DEMILITARIZATION LINES DO NOT USE THE UNPACK AREA. THEREFORE, OPTIONS TO SWITCH TO PROCESSING MUNITIONS VIA THESE LINES COULD BE CONSIDERED IN THE EVENT OF PROJECTED LONG TERM DOWNTIME. (IT IS RECOGNIZED THAT THE REPAIR TIME FOR THIS TYPE OF FAILURE WILL NORMALLY BE MUCH LESS THAN THE TIME REQUIRED TO SWITCH OVER TO PROCESS A DIFFERENT MUNITION.)	1	2	2
1.2	FORKLIFT OPERATIONS WITHIN THE UPA	PLACES PALLET OF MUNITIONS WITHIN THE UPA. REMOVES LARGE DUNNAGE. REMOVES FULL DUNNAGE HOPPERS. REMOVES METAL SCRAP HOPPERS.	MODE - ANY POTENTIAL ACCIDENT OCCURRING DURING FORKLIFT OPERATIONS RESULTING IN EXPLOSION AND/OR AGENT LEAKAGE. CAUSE(S) A. DROPPING A PALLET OF MUNITIONS, RUNNING INTO MUNITIONS WHILE REMOVING DUNNAGE AND/OR DUNNAGE HOPPERS.	POTENTIAL EXPLOSION. (THIS IS CONSIDERED HIGHLY UNLIKELY DUE TO LARGE DESIGN MARGINS ON THE MUNITIONS AND PAST EXPERIENCE WHICH HAS SHOWN THAT THESE MUNITIONS WILL SURVIVE THIS TYPE OF ACCIDENT.) / AGENT LEAKAGE RESULTING IN POSSIBLE PERSONNEL INJURY AND PROBABLE SHUTDOWN OF ALL MUNITIONS DEMILITARIZATION OPERATIONS.	FAILURE DETERRENCE A SAFETY PROGRAM WILL BE IN EFFECT (DETECTORS, CONTINGENCY PROCEDURES, ETC.). PROCEDURES REQUIRE THAT DEMILITARIZATION OPERATIONS WILL NOT BE STARTED UNTIL THE FORKLIFT HAS BEEN REMOVED AND THE OVERHEAD DOOR CLOSED. THERE IS AMPLE ROOM IN THE UPA TO OPERATE THE FORKLIFT TO REMOVE LARGE DUNNAGE AND/OR FULL DUNNAGE HOPPERS AFTER THE PALLET OF MUNITIONS IS BROUGHT INTO THE UPA. IT IS NOT PRACTICAL TO REQUIRE THAT ANY LARGE DUNNAGE AND/OR DUNNAGE HOPPERS (WHICH WILL BE REMOVED ONLY AS THEY BECOME FULL) BE REMOVED FROM THE UPA BEFORE THE PALLET OF MUNITIONS IS BROUGHT INTO THE UPA.	3	1	3

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [X]

COMPONENT LEVEL [ ]

BUILDING BLOCK: NO. 1. UNPACK AREA (UPA)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT	FAILURE CONSEQUENCE PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
1.3	UPA OPERATOR MANUAL OPERATIONS	REMOVE MUNITIONS FROM THEIR STORAGE CONTAINERS, PLACE RESULTING DUNNAGE IN APPROPRIATE HOPPERS, AND MANUALLY (EXCEPT 155 MM (M110 AND M104), 155 MM (M121, M122, AND M121A1), AND 8-INCH (M426) PROJECTILES WHICH ARE HANDLED VIA MECHANICAL AIDS (JIB CRANE, TILT MACHINE, ETC.) LOAD MUNITIONS ONTO THE APPROPRIATE CONVEYOR (ECC OR ECC BYPASS).	MODE - MECHANICAL DAMAGE. CAUSE(S) A. HANDLING OR ACCIDENT DURING HANDLING RESULTING IN AGENT LEAKAGE (I.E. DROPPING, DISASSEMBLY, STRIKING, ETC.).	PROBABLE SHUTDOWN OF ALL MUNITIONS DEMILITARIZATION OPERATIONS.	POTENTIAL AGENT LEAKAGE RESULTING IN POSSIBLE PERSONNEL INJURY.	FAILURE DETERRENCE A SAFETY PROGRAM WILL BE IN EFFECT (DETECTORS, CONTINGENCY PROCEDURES, ETC.). MUNITIONS DESIGN IS SUCH THAT IT IS UNLIKELY THAT SUFFICIENT DAMAGE COULD BE MANUALLY INFLICTED ACCIDENTALLY TO RESULT IN A LEAKAGE.	3	1	3
			MODE - PERSONNEL BECOME EXPOSED TO AGENT VIA THE PRECEDING FAILURE MODE OR WHILE WORKING WITH A PREVIOUSLY UNDETECTED "LEAKER." THE OPERATORS (WHO ARE REQUIRED BY SAFETY CONSIDERATIONS WHEN WORKING WITH BANDED PALLETS TO BE WEARING LEATHER GLOVES AND FACE SHIELDS) MUST REMOVE THEIR PROTECTIVE GEAR AND PUT ON A GAS MASK OR LEAVE THE AREA IMMEDIATELY.	PROBABLE SHUTDOWN OF ALL MUNITIONS DEMILITARIZATION OPERATIONS.	POSSIBLE PERSONNEL INJURY.	FAILURE DETERRENCE SAFETY/TRAINING PROGRAMS WILL INSTRUCT PERSONNEL IN THE PROCEDURES TO BE FOLLOWED TO PRECLUDE THE FAILURE MODE AND/OR TO NEGATE ITS EFFECT.	3	1	3
			MODE - PERSONNEL PICKUP BANDING, PALLET, ETC., THAT HAVE BECOME CONTAMINATED WITH AGENT. CAUSE(S) A. LEAKAGE.	PROBABLE SHUTDOWN OF ALL MUNITIONS DEMILITARIZATION OPERATIONS USING THE UNPACK AREA UNTIL CORRECTED.	POSSIBLE PERSONNEL INJURY.	FAILURE DETERRENCE THE PACKAGED MUNITIONS ARE INSPECTED AT THE STORAGE IGLOO AND AGAIN BEFORE ENTERING THE UNPACK AREA. CORRECTIVE ACTION INSPECTION IN A CLOSED AREA VIA SNIFFING METHODS IS ALSO BEING CONSIDERED.	3	1	3

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [X]
COMPONENT LEVEL [ ]

BUILDING BLOCK: NO. 1. UNPACK AREA (UPA)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL		FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
1.3	UPA OPERATOR MANUAL OPERATIONS (CONTINUED)		MODE - PERSONNEL BECOME EXPLOSED TO AGENT WHILE WORKING WITH THE M23 MINES. CAUSE(S) A. THE DRUMS (CONTAINING THREE MINES) ARE INSPECTED AT THE IGLOO. THE INTERIOR OF THE DRUMS AND THE MINES ARE NOT INSPECTED UNTIL THE DRUMS ARE OPENED IN THE UNPACK AREA. A LEAKER COULD THEREFORE GO UNDETECTED UNTIL THIS POINT.	EQUIPMENT PROBABLE SHUTDOWN OF ALL MUNITIONS DEMILITARIZATION OPERATIONS USING THE UNPACK AREA UNTIL CORRECTED.	PERSONNEL POSSIBLE PERSONNEL INJURY.	FAILURE DETERRENCE PERSONNEL ARE REQUIRED TO WEAR LEVEL "B" CLOTHING WHEN WORKING WITH THE MINES. DISCOLORING OF THE STYROFOAM (BETWEEN EACH MINE AND AT THE TOP AND BOTTOM OF THE DRUM) AND/OR DETERIORATION OF THE DRUM/MINE PAINT IS AN INDICATION OF AGENT LEAKAGE. PROCEDURES REQUIRE THAT THE UNPACK AREA BE VACATED AND THAT THE AREA THEN BE PROPERLY DECONTAMINATED.	2	1	2
			MODE - PERSONNEL BECOME EXPOSED TO AGENT WHILE WORKING WITH THE 105MM M360 CARTRIDGES. CAUSE(S) A. THE CARTRIDGE BOXES (EACH CONTAINING TWO ROUNDS EACH OF WHICH IS PACKAGED IN A FIBERBOARD CONTAINER) ARE INSPECTED FOR VAPOR AT THE IGLOO WITH DETECTORS. THE INTERIOR OF THE BOX AND THE CARTRIDGES ARE NOT INSPECTED VISUALLY UNTIL THE BOXES ARE OPENED IN THE UNPACK AREA. A LEAKER COULD THEREFORE GO UNDETECTED UNTIL THIS POINT. BOXES ARE NOT AIRTIGHT.	PROBABLE SHUTDOWN OF ALL MUNITIONS DEMILITARIZATION OPERATIONS USING THE UNPACK AREA UNTIL CORRECTED.	POSSIBLE PERSONNEL INJURY.	FAILURE DETERRENCE LEAKERS AMONG THIS PARTICULAR MUNITION ARE NOT CONSIDERED A HIGH POSSIBILITY. PROCEDURES REQUIRE THAT THE UNPACK AREA BE VACATED AND THAT THE AREAS THEN BE PROPERLY DECONTAMINATED. GB IS VERY EASY TO DETECT, AND WILL ACTUATE AREA ALARMS.	3	1	3

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [X]
COMPONENT LEVEL [ ]

BUILDING BLOCK: NO. 1. UNPACK AREA (UPA)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL		FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
				EQUIPMENT	PERSONNEL				
1.3	UPA OPERATOR MANUAL OPERATIONS (CONTINUED)		MODE - MECHANICAL DAMAGE CAUSE(S) A. HANDLING OR ACCIDENT DURING HANDLING RESULTING IN EXPLOSION	SHUTDOWN OF ALL MUNITIONS DEMILITARIZATION OPERATIONS.	POTENTIAL EXPLOSION RESULTING IN PROBABLE PERSONNEL INJURY.	FAILURE DETERRENCE MUNITIONS DESIGN IS SUCH THAT IT IS HIGHLY UNLIKELY THAT SUFFICIENT DAMAGE COULD BE MANUALLY INFLICTED ACCIDENTALLY TO RESULT IN AN EXPLOSION. OF ALL THE MUNITIONS THE 4.2 INCH MORTAR IS CONSIDERED TO BE THE ONE POTENTIALLY MOST SUBJECT TO SIGNIFICANT ACCIDENT DURING HANDLING. THE IGNITION CARTRIDGE AND THE PROPELLING CHARGE ARE MANUALLY REMOVED FROM THE MORTAR IN THE UNPACK AREA FOR LATER SHIPMENT TO STORAGE. MISHANDLING OR AN ACCIDENT DURING THE DISMANTLING OPERATIONS COULD RESULT IN AN EXPLOSION AND POSSIBLE INJURY TO PERSONNEL. HOWEVER, PROCEDURES REQUIRE THAT THE ENERGIC COMPONENTS BE SEPARATED UPON REMOVAL, AND PERSONNEL WILL BE REQUIRED TO WEAR PROTECTIVE FACE MASKS AND GLOVES DURING THESE OPERATIONS. THE FUSED 105MM M360 CARTRIDGE IS ALSO CONSIDERED A POTENTIAL EXPLOSIVE HAZARD (THOUGH LESS SO THAN THE MORTAR) DURING HANDLING, SINCE THE PROPELLANT CHARGE AND CARTRIDGE CASE ARE REMOVED IN THE UNPACK AREA FOR LATER SHIPMENT TO STORAGE. CARTRIDGE CASES PACKED WITH M360 PROJECTILES ARE NOT REMOVED FROM THEIR FIBER CONTAINERS. CONTAINERS HAVE LIDS AT EACH END. ONE END CONTAINS THE PROJECTILE. THE OTHER END CONTAINS THE CARTRIDGE CASE. PRECAUTIONS SIMILAR TO THOSE USED WHEN WORKING WITH THE MORTAR ARE IN EFFECT.	3	1	3

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 1. UNPACK AREA (UPA)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
1.3	UPA OPERATOR MANUAL OPERATIONS (CONTINUED)		MODE - LOADING OF MUNITIONS ON THE CONVEYOR INCORRECTLY (BACKWARD).	EQUIPMENT DOWNSTREAM MACHINE DESIGN PREVENTS CATASTROPHIC CONSEQUENCES. THE DEMILITARIZATION PROCESS WOULD HAVE TO BE INTERRUPTED TO REMOVE THE MUNITION.	FAILURE DETERRENCE THE ECC MACHINES AND THE PPD ARE INDEXED SUCH THAT THEY WILL NOT OPERATE IF THE MUNITION IS NOT LOADED CORRECTLY.	1	1	1
1.4	JIB CRANE (FLOOR-MOUNTED PNEUMATICALLY OPERATED)	LIFTS 155 MM (M110 AND M104) PROJECTILES FROM THEIR CARRYING TRAY, HOLDS THEM WHILE THE GROMMET IS REMOVED, AND LOWERS THEM ONTO A TILT MACHINE. LIFTS 155 M (M121, M122, AND M121A1) AND 8-INCH (M426) PROJECTILES FROM THEIR PALLETS, HOLDS THEM WHILE THE STEEL GROMMET IS REMOVED, AND LOWERS THE PROJECTILE ONTO A TILT MACHINE.	MODE - INOPERATIVE FAILURE. CAUSE(S) A. PNEUMATICS LEAKAGE OR JAMMING.	IF THE OPERATORS ARE NOT ALLOWED TO PLACE THE PROJECTILES WHICH WEIGH: 155 MM (M110-99 LB; M104-95 LB) 155 MM (M121-100 LB; M122-100 LB; M121A1-100 LB) 8-INCH (M426-199 LB) ON THE CONVEYOR MANUALLY, OR IF A BACKUP MANUAL HOIST IS NOT AVAILABLE, THE PROCESSING OF THIS MUNITION MUST BE HALTED.	FAILURE DETERRENCE THE CRANE WILL BE INCLUDED IN THE PERIODIC MAINTENANCE PROGRAM. CORRECTIVE ACTION OPTIONS TO OPERATE ANY OF THE OTHER MUNITION DEMILITARIZATION LINES (THE CRANE IS USED ONLY FOR THESE MUNITIONS) COULD BE CONSIDERED. MANUAL CONVEYOR LOADING COULD BE CONSIDERED ONLY IF IT IS WRITTEN INTO THE OPERATIONAL STANDARD OPERATING PROCEDURES (SOP). THERE IS A POSSIBILITY THAT A MANUALLY OPERATED BACKUP HOIST WILL BE PROVIDED	1	1	1

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 1. UNPACK AREA (UPA)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL		FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
1.4	JIB CRANE (FLOOR-MOUNTED PNEUMATICALLY OPERATED) (CONTINUED)		MODE - PROJECTILE BEING LIFTED FALLS TO THE FLOOR. CAUSE(S) A. PNEUMATIC OR MECHANICAL FAILURE.	EQUIPMENT PROJECTILE DESIGN IS SUCH THAT STRESSES OF THE MAGNITUDE LIKELY FROM SUCH A FALL COULD BE TOLERATED. HOWEVER A LIMITED NUMBER OF 155 MM PROJECTILES HAVE STRESS CRACKS IN THEM. THESE CODE H MUNITIONS COULD PRESENT A HAZARD IF MISHANDLED.	PERSONNEL POTENTIAL INJURY TO PERSONNEL STRUCK BY FALLING PROJECTILE.	FAILURE DETERRENCE THE CRANE WILL BE INCLUDED IN THE PERIODIC MAINTENANCE PROGRAM. DESIGN MARGINS ON THE PROJECTILES. SPECIAL HANDLING PROCEDURES FOR THE CODE H MUNITIONS ARE BEING CONSIDERED. CORRECTIVE ACTION OPERATORS WOULD NOT BE IN DIRECT CONTACT WITH THE PROJECTILE AS IT WAS BEING LIFTED.	2	1	2
1.5	TILT MACHINE	ALLOWS THE REPOSITIONING OF 155 MM (M110 AND M104) PROJECTILES FROM A VERTICAL TO A HORIZONTAL POSITION FROM WHICH THEY ARE ROLLED ONTO THE ECC INPUT CONVEYOR; ALLOWS THE REPOSITIONING OF 155 MM (M121, M122, AND M121A1) AND 8-INCH (M426) PROJECTILES FROM A VERTICAL TO A HORIZONTAL POSITION FROM WHICH THEY ARE ROLLED ONTO THE ECC BYPASS CONVEYOR.	MODE - INOPERATIVE. CAUSE(S) A. JAMMING OR STRUCTURAL FAILURE.	IF THE OPERATORS ARE NOT ALLOWED TO PLACE THE PROJECTILES (MAX. WEIGHT 199 LB) ON THE CONVEYOR MANUALLY THE PROCESSING OF THIS MUNITION MUST BE HALTED.		FAILURE DETERRENCE THE TILT MACHINE WILL BE INCLUDED IN THE PERIODIC MAINTENANCE PROGRAM. CORRECTIVE ACTION OPTIONS TO OPERATE ANY OF THE OTHER MUNITION DEMILITARIZATION LINES COULD BE CONSIDERED. MANUAL CONVEYOR LOADING COULD BE CONSIDERED ONLY IF IT IS WRITTEN INTO THE SOP.	1	1	1

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 1. UNPACK AREA (UPA)

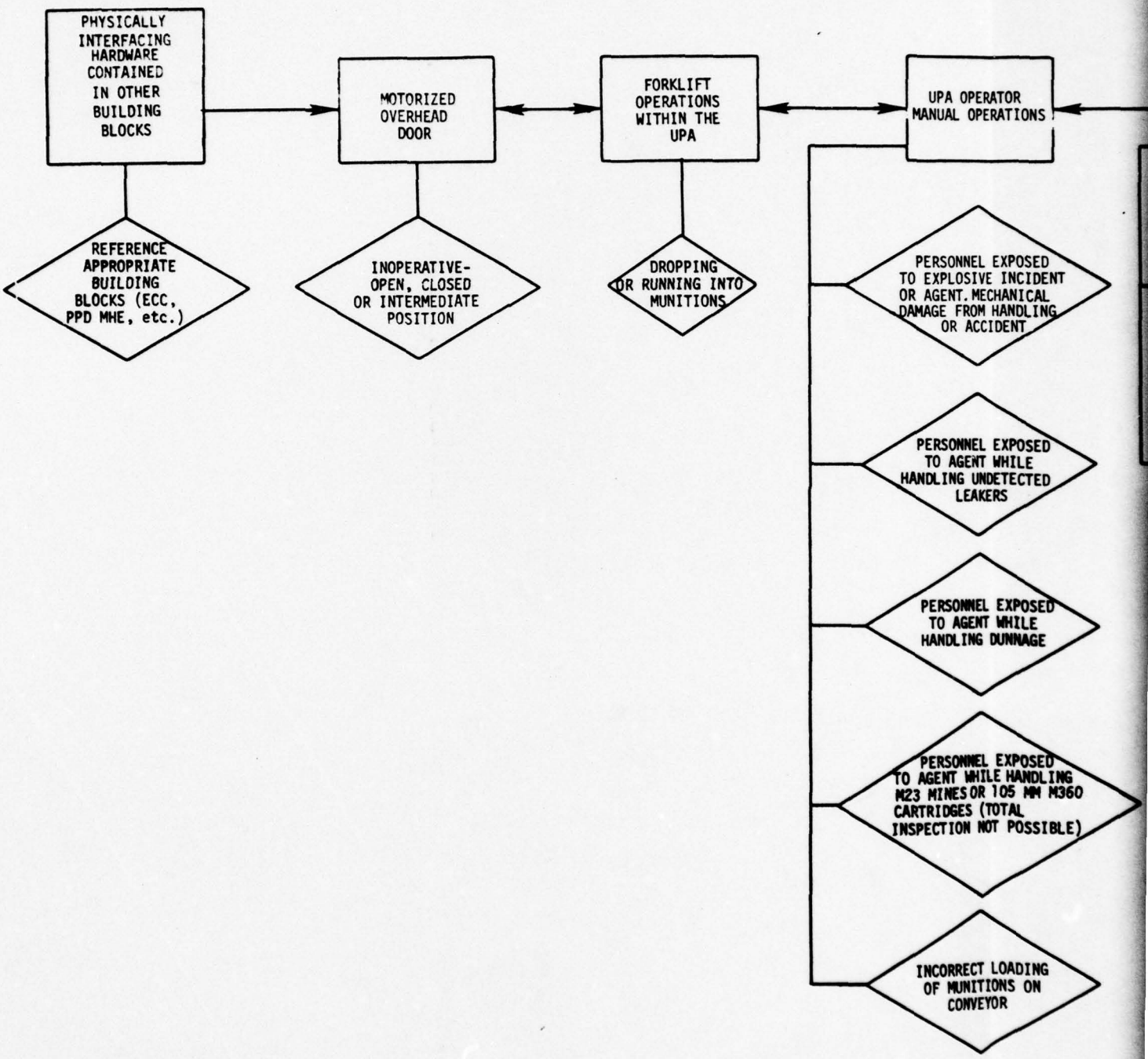
	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
1.5	TILT MACHINE (CONTINUED)		MODE - A PROJECTILE BEING TILTED FALLS TO THE FLOOR. CAUSE(S) A. MECHANICAL OR STRUCTURAL FAILURE.	EQUIPMENT / PERSONNEL PROJECTILE DESIGN IS SUCH THAT STRESSES OF THE MAGNITUDE LIKELY FROM SUCH A FALL COULD BE TOLERATED. HOWEVER, A LIMITED NUMBER OF 155 MM PROJECTILES HAVE STRESS CRACKS IN THEM. THESE CODE H MUNITIONS COULD PRESENT A HAZARD IF MISHANDLED.	FAILURE DETERRENCE THE TILT MACHINE WILL BE INCLUDED IN THE PERIODIC MAINTENANCE PROGRAM. DESIGN MARGINS ON THE PROJECTILES. CORRECTION ACTION SPECIAL HANDLING PROCEDURES FOR THE CODE H MUNITIONS ARE BEING CONSIDERED	2	1	2
1.6	UNPACK AREA (GENERAL)		MODE - POTENTIAL HAZARD TO PERSONNEL IN THE UNPACK AREA FROM HAZARDOUS CONDITIONS EXISTING IN THE INTERIOR OF THE ECC OF WHICH THEY ARE NOT AWARE (FIRE, EXPLOSIONS, ETC.).	POTENTIAL PERSONNEL INJURY.	FAILURE DETERRENCE THE ECC IS DESIGNED TO ISOLATE ALL POTENTIAL HAZARDOUS CONDITIONS EXISTING WITHIN IT. HOWEVER, THERE IS NO REAL TIME WAY FOR PERSONNEL IN THE ADJACENT UNPACK AREA TO KNOW OF SUCH CONDITIONS. CORRECTIVE ACTION PRUDENT SAFETY PRECAUTIONS WOULD MAKE IT DESIRABLE TO EVACUATE THE UNPACK AREA. PERSONNEL IN THE CONTROL MODULE ARE AWARE OF CONDITIONS IN THE ECC ON A REAL TIME BASIS, BUT UNDER THE PRESENT CONDITIONS WOULD HAVE TO DIAL A TWO-DIGIT NUMBER TO RELAY THE INFORMATION TO THE UNPACK AREA. POSSIBILITIES OF REMOVING THE DIALING REQUIREMENT AND/OR INSTALLING AN AUDIBLE ALARM ARE BEING CONSIDERED.	2	1	2
			MODE - POTENTIAL HEARING DAMAGE TO PERSONNEL IN THE UPA. CAUSE(S) A. AN EXPLOSION WITHIN THE ECC EVEN THOUGH CONTAINED.	POTENTIAL PERSONNEL INJURY.	CORRECTIVE ACTION SCHEDULED DYNAMIC TESTING ON THE ECC WILL GIVE DATA ON ACOUSTICS.	2	1	2

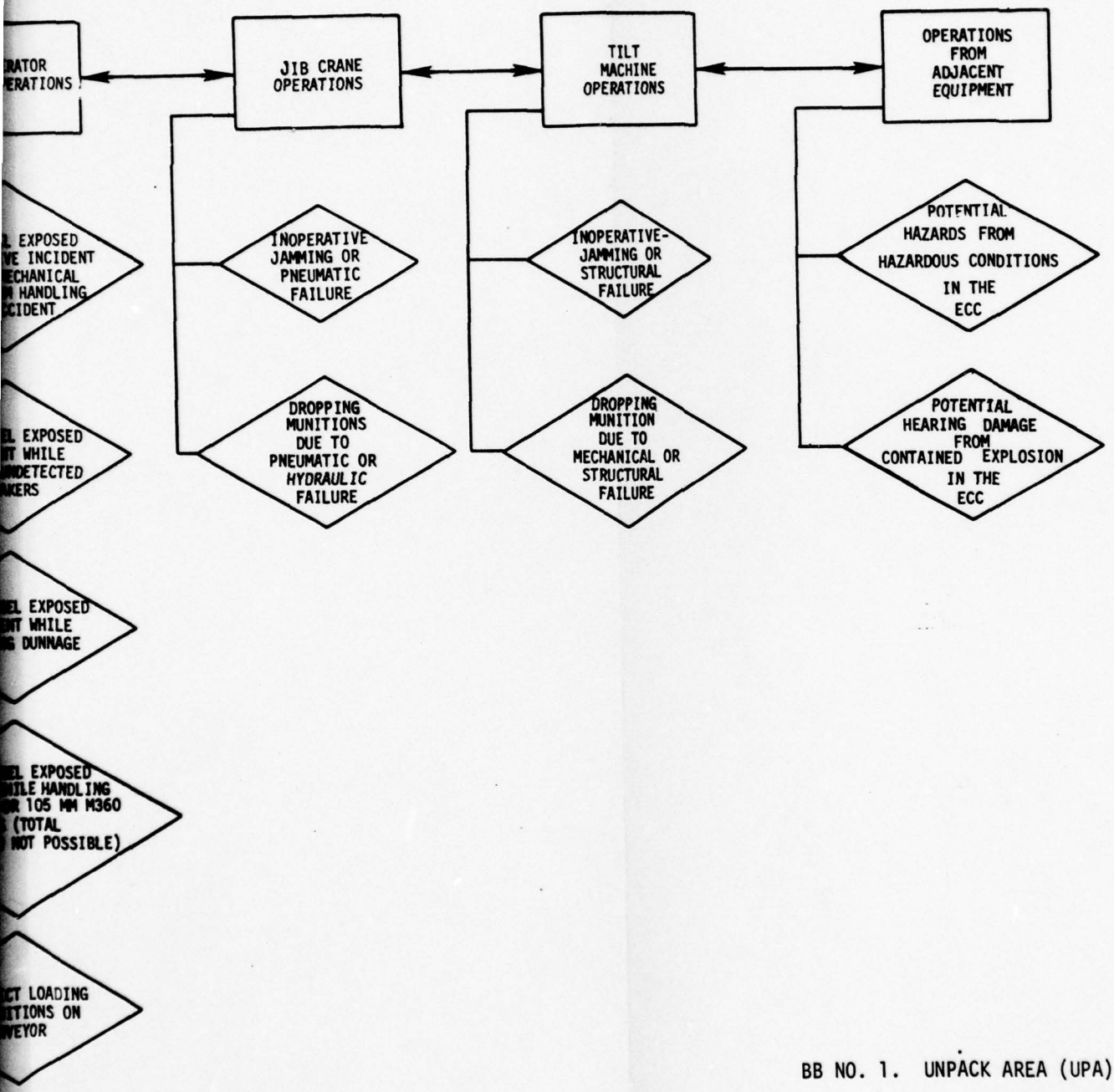
FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 1. UNPACK AREA (LPA)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
1.7	UNPACK AREA HARDWARE WHOSE FAILURE MODES ARE OF MINOR CONSEQUENCE OR SO REMOTE THAT THEY ARE NO CONSIDERED FURTHER HEREIN: SCRAP HOPPERS WORK TABLE EMERGENCY SHOWER PERSONNEL DOOR PNEUMATIC VISE FRESH WATER SHOWER OBSERVATION WINDOW FOOT BATH TOOL STORAGE AREA OVERHEAD RAIL AND HOIST TO THE ECC. (NOT USED DURING NORMAL MUNITION DEMILITARIZATION OPERATIONS.)							


PHYSICALLY INTERFACING HARDWARE CONTAINED IN OTHER BUILDING BLOCKS
MOTORIZED OVERHEAD DOOR
FORKLIFT OPERATIONS WITHIN THE UPA
UPA OPERATOR MANUAL OPERATIONS
REFERENCE APPROPRIATE BUILDING BLOCKS (ECC, PPD MHE, etc.)
INOPERATIVE-OPEN, CLOSED OR INTERMEDIATE POSITION
DROPPING OR RUNNING INTO MUNITIONS
PERSONNEL EXPOSED TO EXPLOSIVE INCIDENT OR AGENT. MECHANICAL DAMAGE FROM HANDLING OR ACCIDENT
PERSONNEL EXPOSED TO AGENT WHILE HANDLING UNDETECTED LEAKERS
PERSONNEL EXPOSED TO AGENT WHILE HANDLING DUNNAGE
PERSONNEL EXPOSED TO AGENT WHILE HANDLING M23 MINES OR 105 MM M360 CARTRIDGES (TOTAL INSPECTION NOT POSSIBLE)
INCORRECT LOADING OF MUNITIONS ON CONVEYOR



BB NO. 1. UNPACK AREA (UPA)

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [X]
COMPONENT LEVEL [X]

BUILDING BLOCK: NO. 2. EXPLOSIVE CONTAINMENT CUBICLE (ECC)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT	FAILURE CONSEQUENCE PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
2.1	EXPLOSIVE CONTAINMENT CUBICLE	RETAIN FRAGMENTS AND CHEMICAL AGENTS THAT WOULD RESULT FROM AN EXPLOSIVE INCIDENT DURING THE PUNCHING AND DRAINING OF AGENT, REMOVAL OF EXPLOSIVES AND SAWING OF PROPELLANT, EXPLOSIVE, STEEL, ALUMINUM, AND FIBER GLASS DURING USE OF THE FOLLOWING BUILDING BLOCKS: NO. 6 RDM NO. 15 PDM NO. 24 MOR NO. 25 MIN	MODE - EXPLOSIVE INCIDENT.		POSSIBLE ACOUSTIC DAMAGE TO PERSONNEL.	CORRECTIVE ACTION THIS WILL BE EVALUATED DURING THE ECC/EXPLOSIVE TEST. AS A RESULT OF THE TEST, APPROPRIATE DESIGN AND OPERATIONAL ACTION WILL BE IMPLEMENTED.	*	3	*
2.2	WALLS, DOORS, AND ACCESS PANELS	RETAIN FRAGMENTS THAT WOULD RESULT FROM AN EXPLOSIVE INCIDENT.	MODE - FIRE. CAUSE(S) A. FAULTY DEMIL OPERATION.	DAMAGE TO DEMIL MACHINERY.		FAILURE DETERRENCE THE ECC IS DESIGNED TO CONTAIN FIRE. CTV COVERAGE PROVIDES VISUAL COVERAGE.	2	4	8
			MODE - RUPTURE OF WALLS, DOORS, OR ACCESS PANEL. CAUSE(S) A. FLYING DEBRIS AND OVERPRESSURE.	RELEASE OF AGENT TO LOW PRESSURE AREA SURROUNDING BUILDING TO THE OUTSIDE ATMOSPHERE. SEE 2.2 ALSO. MACHINERY INSIDE THE ECC COULD BE PARTIALLY OR COMPLETELY DESTROYED.	FLYING DEBRIS FROM THE ECC COULD CAUSE INJURY TO PERSONNEL IN THE UNPACK AREA OR VICINITY OF THE ECC.	FAILURE DETERRENCE WALL THICKNESS IS 2½ INCHES. TESTS CONDUCTED WITH EXPLOSIVES SHOWED A MAXIMUM OF ½-INCH PENETRATION. DOORS ARE INSIDE THE CUBICLE SO THAT HIGHER PRESSURE OR THE IMPACT FROM DEBRIS TENDS TO CLOSE THEM. ALL WELDS WILL BE ULTRASONICALLY TESTED. THE CUBICLE WILL BE HYDROSTATICALLY TESTED AT 250 PSI. ACCESS PANEL TESTS WITH ELECTRICAL AND PNEUMATIC DEVICES HAVE DEMONSTRATED ABILITY TO WITHSTAND EXPLOSIVE CONDITIONS. TESTS WERE CONDUCTED WITHIN A 6-FOOT SPHERE USING 10.4 POUNDS OF C4 EXPLOSIVE. MICROSWITCHES MOUNTED ON THE DOORS ARE REMOTELY MONITORED AND INDICATE IF A DOOR IS CLOSED AND IF IT IS LOCKED. ALL LOCKING PIN CYLINDERS LOCK IN THE CLOSED POSITION IN THE EVENT OF LOSS OF HYDRAULIC	4	1	4

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [ ]
COMPONENT LEVEL [X]

BUILDING BLOCK: NO. 2. EXPLOSIVE CONTAINMENT CUBICLE (ECC)

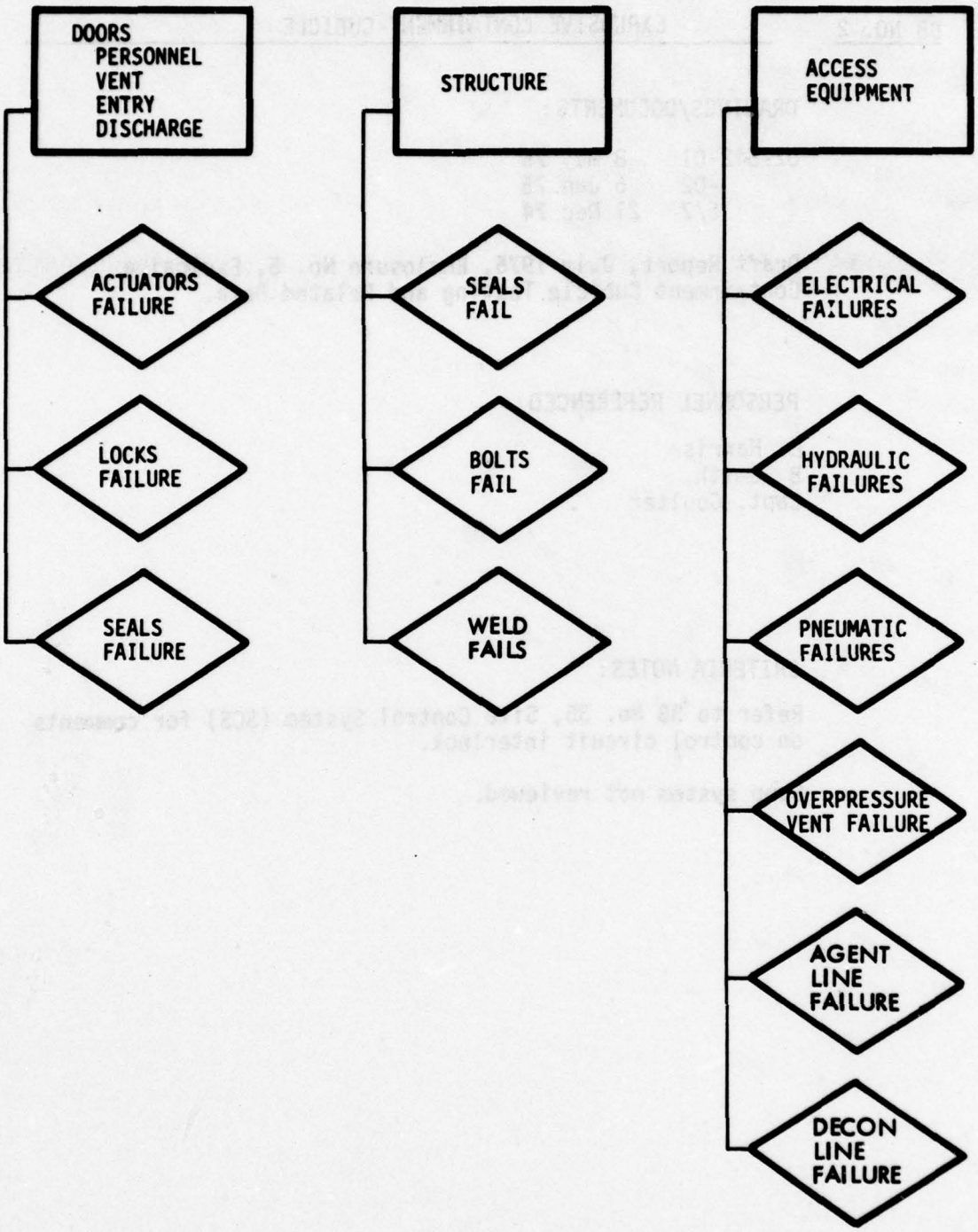
	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
2.2	WALLS, DOORS, AND ACCESS PANELS (CONTINUED)			EQUIPMENT	PRESSURE. IT IS PLANNED TO VENT THE ECC THROUGH A MANUAL VALVE TO THE FILTER SYSTEM IN THE EVENT OF AN EXPLOSIVE INCIDENT. THE MANUAL VALVE WILL BE IN A LOCK BOX. THE VALVE AND ASSOCIATED HARDWARE WERE SELECTED ON THE BASIS OF WORST CASE CONDITIONS (EXPLOSION INVOLVING THE LARGEST MUNITION AND AGENT IN THE VAPOR STATE). THE MAXIMUM PRESSURE EXPECTED IS APPROXIMATELY 160 PSI AND THE BLEED DOWN TIME IS APPROXIMATELY 33 MINUTES. INTERNAL LEAKAGE OF THE VALVE WILL NOT BE A PROBLEM SINCE THE LEAKAGE WILL BE TO THE FILTER.			
2.3	SEALS	RETAIN AGENT THAT WOULD RESULT FROM AN EXPLOSIVE INCIDENT.	MODE - SEAL FAILURE. CAUSE(S) A. OVER PRESSURE COMPRESSION SET, WEAR OUT, DEGRADATION DUE TO EXPOSURE TO DECONTAMINATION SOLUTIONS, AGENT AND HYDRAULIC OIL.	RELEASE OF AGENT FROM THE ECC TO THE LOW PRESSURE AREA SURROUNDING THE ECC. THE SURROUNDING AREA IS EVACUATED BY THE FILTRATION SYSTEM (BB NO. 8).	FAILURE DETERRENCE DOORS ARE INSIDE THE CUBICLE SO THAT THE HIGHER PRESSURE INSIDE THE ECC CAUSES FURTHER COMPRESSION OF SEALS. THE ECC WILL BE HYDROSTATICALLY TESTED AT 250 PSI. DOOR SEALS ARE DESIGNED FOR BETTER SEALING WITH GREATER PRESSURE. THE CLOSE CYLINDER (ON THE SMALL DOOR) APPLIES A FINAL PRESSURE ON THE DOOR SEAL OF 22,000-LB MAXIMUM. THE CLOSE CYCLINDERS WILL OPERATE SATISFACTORILY WITH A PRESSURE RANGE OF 900 TO 1000 PSI IN THE ECC HYDRAULIC SYSTEM. (CALCULATIONS SHOW SATISFACTORY OPERATION EVEN IN THE 800 PSI RANGE.) DOOR SEAL TESTS OF 24,000 CYCLES SHOW NO SEAL DEGRADATION. END FLANGE SEALS ARE NEOPRENE AND A METAL TO METAL CONTACT SURFACE. ROUTINE VISUAL INSPECTION AND REPLACEMENT OF DOOR SEALS WILL BE A PART OF A MAINTENANCE PROGRAM. SEE ALSO 2.1 NOTE AND ABOVE.	1	3	3

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 2. EXPLOSIVE CONTAINMENT CUBICLE (ECC)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL		FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
2.3	SEALS (CONTINUED)			EQUIPMENT	PERSONNEL	CORRECTIVE ACTION SEALS WILL BE TESTED AND EVALUATED DURING THE EXPLOSIVE TEST ON THE ECC USING BAGS OVER THE SEALS AND FROM INSIDE THE ECC.			
2.4	DOORS	A. INLET AND OUTLET FOR MUNITIONS. B. PERSONNEL ACCESSS. C. VENT TO FILTRATION SYSTEM (BB. NO. 22).	MODE - FAILURE TO OPEN, CLOSE OR LOCK WHEN PROGRAMMED.	ENTRY AND REMOVAL OF CONVEYORS WILL CONFLICT WITH DOORS CAUSING EQUIPMENT DAMAGE. OPEN DOORS AT THE WRONG TIME WOULD PERMIT RELEASE OF AGENT TO THE LOW PRESSURIZATION AREA SURROUNDING THE ECC. THE SURROUNDING AREA IS EVAUCATED BY THE FILTRATION SYSTEM (Bb NO. 23).		FAILURE DETERRENCE LIMIT SWITCHES SENSE THE POSITION OF THE DOORS AND LOCKS. IN THE EVENT THAT THE POSITION IS SENSED IN THE WRONG POSITION, THE COMPUTER PROGRAM IS STOPPED AND FURTHER PROCESSING IS STOPPED.	1	3	3
			MODE - OPEN DOORS AT THE WRONG TIME (A SECOND ORDER FAILURE) DURING DEMIL OPERATIONS.	EXIT OF DEBRIS IN THE EVENT OF EXPLOSIVE INCIDENT.		FAILURE DETERRENCE POSITION SWITCHES ON DOORS AND DOOR LOCKS INHIBIT DEMIL OPERATION THROUGH THE CONTROL SYSTEM.	4	1	4
			MODE FIRE HAZARD TO MAINTENANCE PERSONNEL INSIDE ECC DURING NON-OPERATIONAL MAINTENANCE ACTIVITIES. THIS TYPE MODE NOT NORMALLY CONSIDERED HEREIN DUE TO NON-PROCESSING ACTIVITY AND ITS SECONDARY OR TERTIARY FAILURE LEVEL. *FOR INFORMATION ONLY.	POSSIBLE SEVERE DAMAGE TO INSTALLED MACHINES AND EQUIPMENTS	POTENTIAL PERSONNEL INJURY	FAILURE DETERRENCE MAINTENANCE PERSONNEL WILL PROBABLY CARRY HAND EXTINGUISHERS. DETAILS OF POSSIBLE GENERAL FIRE PROTECTION SYSTEM FOR ALL AREAS OF CAMDS NOT AVAILABLE. CORRECTIVE ACTION DOORS CANNOT BE CLOSED TO SMOTHER FIRE WITHOUT POSSIBLE FURTHER ADVERSE EFFECTS ON ENCLOSED PERSONNEL. A GENERAL ADEQUACY REVIEW OF FIRE PROTECTION SYSTEMS/PROCEDURES SHOULD BE MADE, AND SYSTEMS IMPLEMENTED FOR CAMDS ACUTE AREAS, E.G., ECC.	*	*	*



BB NO. 2. EXPLOSIVE CONTAINMENT CUBICLE (ECC)

FMEA INFORMATION SOURCES

BB NO. 2 — **EXPLOSIVE CONTAINMENT CUBICLE**

DRAWINGS/DOCUMENTS:

02-512-01 8 May 75
-02 6 Jun 75
6/7 21 Dec 74

Draft Report, July 1975, Enclosure No. 5, Explosive Containment Cubicle Testing and Related Data.

PERSONNEL REFERENCED:

E. Harris
B. Smith
Capt. Coulter

CRITERIA NOTES:

Refer to BB No. 35, Site Control System (SCS) for comments on control circuit interlock.

Sump system not reviewed.

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [X]

COMPONENT LEVEL [X]

BUILDING BLOCK: NO. 4. DEACTIVATION FURNACE SYSTEM (DFS)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
4.1	ROTARY KILN FURNACE	THERMALLY DEACTIVATE AND DETOXIFY AGENT AND EXPLOSIVE COMPONENTS.	MODE - BURNER FAILURE. CAUSE(S) A. FUEL LINE (OR FILTER) PLUGGED AND FLAME GOES OUT. B. LOSS OF COMBUSTION AIR (BLOWER FAILURE) AND FLAME GOES OUT. C. FUEL TANK EMPTY AND FLAME GOES OUT.	EQUIPMENT SHUTDOWN AND MAINTENANCE.	FAILURE DETERRENCE A LOW TEMPERATURE ALARM IS PROVIDED. AN ULTRAVIOLET FLAME SCANNER IS ALSO PROVIDED. BOTH AUTOMATIC (INTERLOCKED) AND EMERGENCY MANUAL SHUTDOWN CAPABILITY EXISTS. (AUTOMATIC RELITE CAPABILITY IS PROVIDED.) A LOW LEVEL ALARM IS PROVIDED IN THE FUEL TANK WITH AN INTERLOCK TO THE AUTOMATIC SHUTDOWN SEQUENCE. IN ANY CASE DETOXIFICATION WOULD CONTINUE UTILIZING RESIDUAL HEAT IN THE FURNACE AND AFTERBURNER OPERATION. IT IS REGARDED AS EXTREMELY UNLIKELY THAT ANY TOXIC MATERIAL WOULD BE RELEASED TO THE OUTSIDE AREA. (TOXIC RELEASE WOULD BE TO THE AFTERBURNER AND SCRUBBING SYSTEM.) CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	2	1	2

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 4. DEACTIVATION FURNACE SYSTEM (DFS)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
4.1	ROTARY KILN (CONTINUED)		D. RETORT TEMPERATURE TOO LOW DUE TO FAILURE OF THE TEMPERATURE CONTROL SYSTEM.	EQUIPMENT: SHUTDOWN AND MAINTENANCE. PERSONNEL:	FAILURE DETERRENCE LOW TEMPERATURE ALARM PROVIDED. A LOW TEMPERATURE IS INTERLOCKED WITH CONVEYOR AND FURNACE ROTATION TACHOMETER. CONTINUOUS TEMPERATURE MONITORING ALSO PROVIDED. A VENTILATED BARRIER ENCLOSURE SURROUNDS THE FURNACE AREA. IN ADDITION, THE EXIT CONVEYOR IS HEATED AND WOULD PROVIDE A BACKUP MODE FOR EXPLOSIVE COMPONENTS DEACTIVATION. THE OCCURRENCE OF TOXIC RELEASE AND/OR DANGER OF LIVE EXPLOSIVES PASSING THROUGH THE RETORT IS REGARDED AS EXTREMELY REMOTE. CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	3	1	3
			MODE - EXPLOSION CAUSE(S) A. BUILDUP OF MUNITIONS DUE TO JAMMING AND MOTION SENSORS FAIL--BOTH IN AND OUT.	POTENTIAL DAMAGE TO FURNACE. SHUTDOWN AND MAINTENANCE. POTENTIAL TOXIC RELEASE (VENT TO ATMOSPHERE. THE CONCRETE ENCLOSURE WOULD CONTAIN ALL FRAGMENTS.)	FAILURE DETERRENCE PROPER SPACING OF MUNITIONS. BLAST DISSIPATION BAFFLE BETWEEN FURNACE AND CYCLONE. CYCLONE DESIGNED TO WITHSTAND OVERPRESSURE. TV SURVEILLANCE PROVIDED (AT THE FURNACE EXIT). MOTION SENSORS ARE PROVIDED BUT ARE NOT INTERLOCKED TO CONVEYOR OPERATION. THE RETORT IS HOUSED WITHIN A PROTECTIVE BARRIER ENCLOSURE. ALSO A GREAT DEAL OF TESTING IN A PILOT PLANT KILN HAS BEEN CONDUCTED WHERE JAMMING OCCURRED. UNDER THESE CONDITIONS, IN NO CASE DID A FAILURE (EXPLOSION) OCCUR (DUE TO JAMMING ONLY). THIS FAILURE MODE CAUSING TOXIC RELEASE TO THE OUTSIDE AREA IS CONSIDERED TO BE VERY REMOTE.	3	1	3

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 4. DEACTIVATION FURNACE SYSTEM (DFS)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL		FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
4.1	ROTARY KILN (CONTINUED)					CORRECTIVE ACTION IT IS RECOMMENDED THAT THE MOTION SENSORS BE INTERLOCKED TO THE CONVEYOR FEED.			
			MODE - LACK OF EXCESS AIR FOR COMBUSTION. CAUSE(S) FAILURE OF INDUCED DRAFT FAN.	EQUIPMENT SHUTDOWN AND MAINTENANCE.	PERSONNEL POTENTIAL TOXIC RELEASE TO SIX LEVEL VENTILATION AREA AND ABSOLUTE CHARCOAL FILTER SYSTEM.	FAILURE DETERRENCE THE DRAFT FAN IS INTERLOCKED WITH FURNACE OPERATION; AUTOMATIC SHUTDOWN IS INITIATED IN THE EVENT THAT THE FAN FAILS. THE POSSIBILITY OF BOTH FANS AND AUTOMATIC SHUTDOWN FAILING (AND THE CHARCOAL FILTERING SYSTEM) CAUSING TOXIC RELEASE TO THE OUTSIDE AREA IS REGARDED AS EXTREMELY REMOTE. CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	2	2	4
			MODE - RETORT TEMPERATURE TOO HIGH. CAUSE(S) A. TEMPERATURE CONTROL (AIR/FUEL RATIO, TOTAL FLOW RATES, ETC.) SYSTEM FAILS.	SHUTDOWN AND MAINTENANCE. POSSIBLE DAMAGE TO EQUIPMENT.		FAILURE DETERRENCE HIGH TEMPERATURE ALARM PROVIDED. CONTINUOUS TEMPERATURE MONITORED ON CHART. CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	2	2	4

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 4. DEACTIVATION FURNACE SYSTEM (DFS)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL		FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
4.1	ROTARY KILN (CONTINUED)		MODE - LOSS OF KILN ROTATION. CAUSE(S) A. FAILURE OF DRIVE MOTOR AND MOTION SENSING SYSTEM FAILS.	EQUIPMENT POSSIBLE EXPLOSION DUE TO MUNITION BUILDUP AT ENTRANCE. SHUTDOWN AND MAINTENANCE.	PERSONNEL POTENTIAL TOXIC RELEASE TO OUTSIDE AREA. THE CONCRETE ENCLOSURE WOULD CONTAIN ALL FRAGMENTS.	FAILURE DETERRENCE LOSS OF ROTATION ALARM PROVIDED. AUTO SYSTEM SHUTDOWN PROVIDED. PROPER SPACING OF MUNITIONS. BLAST DISSIPATION BAFFLE BETWEEN FURNACE AND CYCLONE. CYCLONE DESIGNED TO WITHSTAND OVERPRESSURE. TV SURVEILLANCE PROVIDED (AT THE FURNACE EXIT). MOTION SENSORS ARE PROVIDED BUT ARE NOT INTERLOCKED TO CONVEYOR OPERATION. THE RETORT IS HOUSED WITHIN A PROTECTIVE BARRIER ENCLOSURE. ALSO A GREAT DEAL OF TESTING IN A PILOT PLANT KILN HAS BEEN CONDUCTED WHERE JAMMING OCCURRED. UNDER THESE CONDITIONS, IN NO CASE DID A FAILURE (EXPLOSION) OCCUR (DUE TO JAMMING ONLY). THIS FAILURE MODE CAUSING TOXIC RELEASE TO THE OUTSIDE AREA IS CONSIDERED TO BE VERY REMOTE. CORRECTIVE ACTION IT IS RECOMMENDED THAT THE MOTION SENSORS BE INTERLOCKED TO THE CONVEYOR FEED.	3	1	3

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL [X]

BUILDING BLOCK: NO. 4. DEACTIVATION FURNACE SYSTEM (DFS)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
4.2	CYCLONE	REMOVAL OF LARGE FIBER GLASS PARTICLES EMITTED FROM ROTARY KILN.	MODE - HIGH TEMPERATURE. CAUSE(S) A. RETORT TEMPERATURE CONTROL SYSTEM FAILS.	EQUIPMENT / PERSONNEL POTENTIAL EQUIPMENT DAMAGE. SHUTDOWN AND MAINTENANCE.	FAILURE DETERRENCE HIGH TEMPERATURE ALARM ON DEACTIVATION FURNACE (ALSO CONTINUOUS MONITORING OF TEMPERATURE). HIGH TEMPERATURE MATERIALS OF CONSTRUCTION INFILTRATION COOLING AIR IN THE ENTRANCE END OF THE FURNACE. CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	2	2	4
			B. EXCESSIVE BURNING IN ROTARY KILN DUE TO EXPLOSIVES BUILDUP.	POTENTIAL EQUIPMENT DAMAGE. SHUTDOWN AND MAINTENANCE.				
			MODE - BLAST DAMAGE. CAUSE(S) A. EXPLOSION IN ROTARY KILN.	POTENTIAL EQUIPMENT DAMAGE. SHUTDOWN AND MAINTENANCE. / POSSIBLE PERSONNEL INJURY. TOXIC RELEASE TO ABSOLUTE CHARCOAL FILTERS.	FAILURE DETERRENCE BLAST ATTENUATION DUCT SYSTEM INSTALLED BETWEEN DEACTIVATION FURNACE AND CYCLONE. ALSO CYCLONE HOUSED WITHIN A SHROUDED AND VENTILATED AREA (VENTED AT SIX CHANGES/HOUR THROUGH ABSOLUTE CHARCOAL FILTERS). CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	3	1	3
			MODE - SYSTEM BLOCKAGE. CAUSE(S) A. EXIT VALVE (DUMP) OR LINE BLOCKED WITH FIBER GLASS AND OPERATOR TAKES NO ACTION.	SHUTDOWN AND MAINTENANCE.	FAILURE DETERRENCE ΔP MONITORED ACROSS CYCLONE (WITH ALARM). ACCESS PORT FOR CLEANING WILL BE PROVIDED. ROUTINE CHECK INTERVAL MAY BE SHORTENED. CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	2	1	2

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL [X]

BUILDING BLOCK: NO. 4. DEACTIVATION FURNACE SYSTEM (DFS)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL		FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
4.3	SLAGGING AFTERBURNER	THERMAL DECOMPOSITION OF RESIDUAL CHEMICAL AGENTS AND REMOVAL OF FINE FIBER GLASS PARTICLES (AS A SLAG).	MODE - BURNER FLAME OUT. CAUSE(S) A. LOSS OF FUEL-LINE PLUGGED AT FILTER. B. BLOWER FAILURE (LOSS OF COMBUSTION AIR). C. FUEL SUPPLY TANK EMPTY.	EQUIPMENT SHUTDOWN AND MAINTENANCE.	PERSONNEL TOXIC RELEASE TO CAUSTIC SCRUBBING SYSTEM.	FAILURE DETERRENCE REDUNDANT FUEL OIL SUPPLY FILTERS. ULTRAVIOLET FLAME SCANNER INTERLOCKED WITH BURNER FUEL AND AIR SUPPLY FOR AUTO SHUTDOWN. AFTERBURNER TEMPERATURE IS CONTINUOUSLY MONITORED. LOW PRESSURE AIR ALARM. HIGH AND LOW LEVEL ALARMS IN FUEL TANK. THE TOXIC RELEASE SHOULD BE MINIMAL (IF ANY) TO THE SCRUBBING SYSTEM SINCE RESIDUAL HEAT WILL DETOXIFY FLUE GASES. SCRUBBERS REMOVE AGENT.	2	2	4
			MODE - AFTERBURNER TEMPERATURE TOO HIGH. CAUSE(S) A. FAILURE OF AFTERBURNER CONTROLLER FUNCTION (AIR AND FUEL TO BURNERS) OR FAILURE OF THERMOCOUPLE IN BURNER CHAMBER.	POSSIBLE DAMAGE. SHUTDOWN AND MAINTENANCE.		CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED. FAILURE DETERRENCE HIGH TEMPERATURE ALARM WITH A CONTINUOUS TEMPERATURE MONITOR. CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	2	1	2
			MODE - AFTERBURNER TEMPERATURE TOO LOW. CAUSE A. FAILURE OF BURNER CONTROL SYSTEM. AUTO SHUTDOWN SYSTEM FAILS.		POTENTIAL TOXIC VAPOR RELEASE TO CAUSTIC SCRUBBING SYSTEM (LACK OF DECOMPOSITION).	FAILURE DETERRENCE LOW TEMPERATURE ALARM WITH INTERLOCK TO EMERGENCY (AUTO) SHUTDOWN. THE TOXIC RELEASE SHOULD BE MINIMAL (IF ANY) TO THE SCRUBBING SYSTEM SINCE RESIDUAL HEAT WILL DETOXIFY FLUE GASES. SCRUBBERS REMOVE AGENT. THE RELEASE OF TOXIC MATERIAL TO THE OUTSIDE AREA IS REGARDED AS EXTREMELY REMOTE. CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	2	1	2

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 4. DEACTIVATION FURNACE SYSTEM (DFS)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
4.4	GAS QUENCH TOWER	SUPER SATURATION OF HOT FLUE GASES FROM SLAGGING AFTERBURNER PRIOR TO ENTERING VENTURI SCRUBBER.	MODE - HIGH QUENCH ZONE TEMPERATURE. CAUSE(S) A. INLET PUMP OR CONTROL VALVE FAILS AND OPERATOR FAILS TO TAKE ACTION. B. QUENCH MAKEUP WATER VALVE FAILS AND OPERATOR FAILS TO TAKE ACTION.	EQUIPMENT POSSIBLE TOWER DAMAGE. POSSIBLE TOWER DAMAGE.	FAILURE DETERRENCE HIGH TEMPERATURE ALARM.- AUTO SYSTEM SHUTDOWN PROVIDED. LOW PRESSURE AND FLOW ALARM. REMOTE MANUALLY OPERATED REDUNDANT VALVE PROVIDED. REMOTE MANUAL VALVE WITH EMERGENCY WATER SUPPLY. CORRECTIVE ACTION NONE RECOMMENDED.	2	1	2
			MODE - EMPTY QUENCH TOWER CAUSE(S) LEVEL CONTROL VALVE IN DOWNSTREAM SCRUBBER TOWER FAILS OR QUENCH BRINE PUMP (P-302) FAILS, OR CONTROL VALVE FAILS.	POSSIBLE TOWER DAMAGE (LOSS OF FLOW TO QUENCH TOWER AND VENTURI SCRUBBER).	FAILURE DETERRENCE LOW LEVEL AND FLOW ALARMS ARE PROVIDED FOR BOTH THE QUENCH TOWER AND VENTURI SCRUBBER. (THE SCRUBBER TOWER ALSO HAS FIVE LEVEL ALARMS AND A PRESSURE ALARM.) IN ADDITION A TEMPERATURE SWITCH (VENTURI SCRUBBER FLUE GAS OUTLET) WOULD INITIATE EMERGENCY WATER FLOW FROM THE 3000-GALLON HEAD TANK. FINALLY, AUTOMATIC FURNACE AND AFTERBURNER SHUTDOWN WOULD BE INITIATED. CORRECTIVE ACTION NONE RECOMMENDED.	2	1	2

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 4. DEACTIVATION FURNACE SYSTEM (DFS)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL		FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
4.5	VENTURI SCRUBBER	PARTICULATE COLLECTION AND CHEMICAL SCRUBBING.	MODE - LOSS OF BRINE FLOW TO VENTURI.	EQUIPMENT	PERSONNEL				
			CAUSE(S)			FAILURE DETERRENCE	2	1	2
			A. VENTURI BRINE PUMP (FLOW FROM SCRUBBER TOWER) FAILS (LOSS OR REDUCED SCRUBBING ACTION).		POSSIBILITY OF RELEASE OF GASES TO CAUSTIC SCRUBBER.	AUTO OPEN BYPASS VALVE AND LEVEL CONTROL VALVE. LOW PRESSURE ALARM. HIGH TEMPERATURE ALARM WITH AUTO SHUTDOWN OR FURNACE AND AFTERBURNER.			
			B. REMOTE FLOW CONTROLLER FAILURE.		POSSIBILITY OF RELEASE OF GASES TO CAUSTIC SCRUBBER.	LOW FLOW ALARM. MANUAL FLOW ADJUSTMENT PROVIDED. HIGH TEMPERATURE ALARM WITH AUTO SHUTDOWN OF FURNACE AND AFTERBURNER.			
						CORRECTIVE ACTION NONE RECOMMENDED.			
			MODE - VENTURI THROAT PLUG MISALIGNMENT.						
			CAUSE(S)			FAILURE DETERRENCE	2	1	2
			A. THROAT PLUGGED OR CLOSED DUE TO MALFUNCTION OF ELECTRICAL DIFFERENTIAL PRESSURE CONTROLLER CAUSING FURNACE OVERPRESSURIZATION.	SHUTDOWN AND MAINTENANCE	POSSIBLE TOXIC RELEASE TO CAUSTIC SCRUBBER AND FURNACE HOUSING (SIX-LEVEL AIR CHANGE AREA THROUGH CHARCOAL FILTERS).	HIGH DIFFERENTIAL PRESSURE ALARM. PROVISION FOR MANUAL CONTROL OF THROAT PLUG. AUTOMATIC SHUTDOWN OF FURNACE AND AFTERBURNER.			
			B. THROAT OPEN TOO FAR DUE TO PRESSURE CONTROLLER MALFUNCTION - LOSS OR REDUCED SCRUBBING ACTION.	SHUTDOWN AND MAINTENANCE		LOW DIFFERENTIAL PRESSURE ALARM. PROVISION FOR MANUAL CONTROL OF THROAT PLUG.			
						CORRECTIVE ACTION NONE RECOMMENDED.			

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL [X]

BUILDING BLOCK: NO. 4. DEACTIVATION FURNACE SYSTEM (DFS)

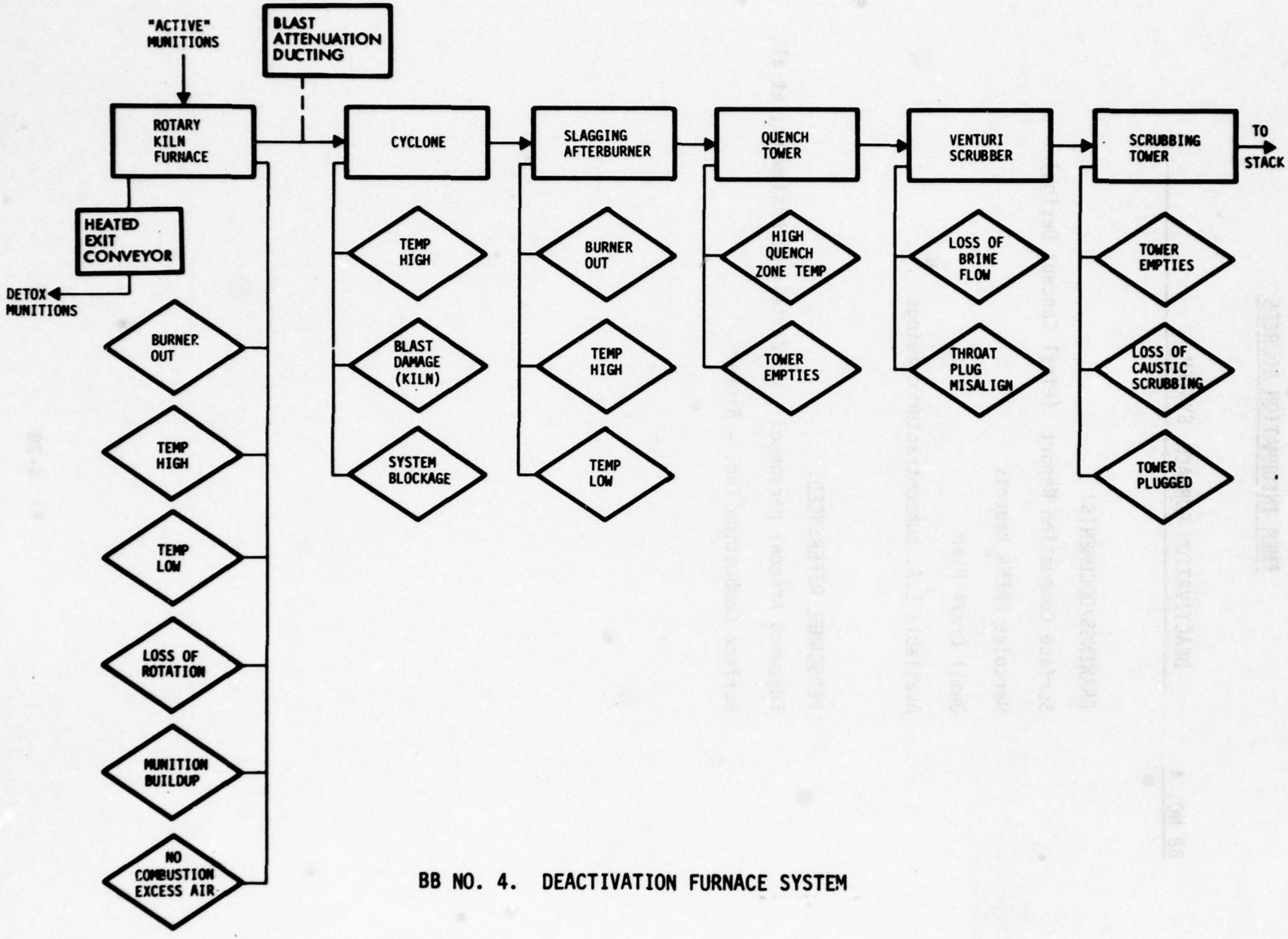
	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL		FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
4.6	SCRUBBING TOWER	TO REMOVE FLUE GAS CONTAMINANTS THAT REQUIRE LONGER CONTACT TIMES.	MODE - TOWER EMPTIES. CAUSE(S) A. FAILURE OPEN OF LEVEL CONTROL VALVE AND AUTO SHUTDOWN SYSTEM FAILS.	EQUIPMENT POTENTIAL EQUIPMENT DAMAGE. SHUTDOWN AND MAINTENANCE.	PERSONNEL	FAILURE DETERRENCE LOW LEVEL ALARM AND AUTO SHUTDOWN PROVIDED (FURNACE AND AFTERBURNER AUTO DE-ENERGIZE LEVEL CONTROL VALVE.) CORRECTIVE ACTION NONE REQUIRED.	2	1	2
			MODE - LOSS OF CAUSTIC SCRUBBING CAPABILITY. CAUSE(S) A. CAUSTIC PUMP FAILURE AND OPERATOR FAILS TO TAKE ACTION. B. pH CONTROL FAILURE AND OPERATOR FAILS TO TAKE ACTION.	SHUTDOWN AND MAINTENANCE.	EMISSION STANDARDS MAY BE EXCEEDED (BUT NOT AGENT).	FAILURE DETERRENCE LOW PRESSURE ALARM ON PUMP (ALSO MANUAL SWITCH CAPABILITY TO A STANDBY PUMP IS PROVIDED) LOW pH ALARM PROVIDED. MANUALLY ADJUST CONTROL VALVE. CORRECTIVE ACTION NONE REQUIRED.	2	1	2
			MODE - TOWER PLUGGED. CAUSE(S) A. DEMISTER AND/OR PACKED SECTION PLUGGED - REDUCED GAS FLOW AND FURNACE/AFTERBURNER OVER PRESSURIZATION. OPERATOR FAILS TO TAKE ACTION.	SHUTDOWN AND MAINTENANCE.	EMISSION STANDARDS MAY BE EXCEEDED (BUT NOT AGENT).	FAILURE DETERRENCE HIGH DIFFERENTIAL PRESSURE ALARM TO SAFE MODE CONDITION(MANUALLY INITIATE FURNACE AND AFTERBURNER SHUTDOWN IF ΔP TOO HIGH). CORRECTIVE ACTION NONE REQUIRED.	2	1	2
			MODE - TOWER OVERFILLS. CAUSE(S) A. PLUGGED PURGE PUMP SUCTION OR LEVEL CONTROL VALVE FAILURE.	SHUTDOWN AND MAINTENANCE.		FAILURE DETERRENCE MANUALLY PURGE SUCTION LINE. AUTO SHUTDOWN OF FURNACE AND AFTERBURNER. CORRECTIVE ACTION NONE REQUIRED.	2	1	2

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 4. DEACTIVATION FURNACE SYSTEM (DFS)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
4.7	A. DEACTIVATION FURNACE INPUT CONVEYOR (ROCKET) B. DEACTIVATION FURNACE INPUT CONVEYOR (PROJECTILE) C. DEACTIVATION FURNACE INPUT CONVEYOR(MINE) D. DEACTIVATION FURNACE INPUT CONVEYOR (MORTAR)	TRANSPORT DEMILLED MUNITION ELEMENTS TO THE DEACTIVATION FURNACE.	MODE - FAILURE TO CONVEY MUNITION. CAUSE(S) ACTUATION MOTOR FAILURE.	EQUIPMENT MUNITIONS LINE INTERRUPTION WHILE ERROR IS CORRECTED.	FAILURE DETERRENCE EACH CONVEYOR HAS A SENSOR TO DETECT MOTION. (REFERENCE BB NO. 35 SCS)	1	4	4
			MODE - EXPLOSIVE AND/OR PROPELLANT FIRE FROM CHIPS GENERATED DURING PROCESSING.	PERSONNEL POTENTIAL AGENT RELEASE TO ATMOSPHERE AND/OR PERSONNEL EXPOSURE.	FAILURE DETERRENCE A MAINTENANCE PROGRAM WILL REMOVE THE MATERIAL. NO SOURCE OF IGNITION HAS BEEN IDENTIFIED FROM THE CONVEYORS. THEREFORE, THIS FAILURE MODE REPRESENTS AT LEAST A SECOND ORDER OCCURRENCE.	3	1	3



BB NO. 4. DEACTIVATION FURNACE SYSTEM

FMEA INFORMATION SOURCES

BB NO. 4 DEACTIVATION FURNACE SYSTEM

DRAWINGS/DOCUMENTS:

Surface Combustion Report (Final Concept Design)

Hercules FMEHA Reports

Demil Draft Plan

Available E.A. subcontractor drawings

PERSONNEL REFERENCED:

Edgewood Arsenal personnel - J. Bartel, R. Misiewicz, et al.

Surface Combustion Inc. - Rinker

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [X]
COMPONENT LEVEL [X]

BUILDING BLOCK: NO. 5. METAL PARTS FURNACE (MPF)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL		FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
				EQUIPMENT	PERSONNEL				
5.1	METAL PARTS FURNACE (PUNCHING CHAMBER)	TO PIERCE BULK ITEMS PRIOR TO VOLATILIZATION AND BURNING (ACTS AS ENTRANCE CUBICLE FOR OTHER ITEMS).	MODE - BULK CONTAINER NOT OPENED SUFFICIENTLY AND CONTAINER LEAVES PUNCH AREA. CAUSE(S) A. HYDRAULIC FAILURE OF PUNCH.	POTENTIAL DAMAGE SHUTDOWN AND MAINTENANCE. POSSIBLE EXPLOSION SHOULD CONTAINER REACH THE BURN-OUT CHAMBER (EXTREMELY REMOTE).	TOXIC RELEASE, BUT ONLY IF EXPLOSION OCCURS. OTHERWISE INCOMPLETE BURNING OF MUSTARD.	FAILURE DETERRENCE PUNCH TRAVEL LENGTH ALARM PROVIDED. POSITION SWITCH ON ROLLER TRAY INTERLOCKED TO PUNCH. TV MONITORING. THE MODE WHERE THE CONTAINER REACHES THE BURNOUT CHAMBER, WHERE SERIOUS DAMAGE COULD OCCUR (IF CONTAINER FILLED AND NOT PUNCHED), IS REGARDED AS EXTREMELY REMOTE. THE SERIES REDUNDANT SURVEILLANCE AND INTERLOCKING FEATURES SEEM TO BE ENTIRELY ADEQUATE TO PRECLUDE A SERIOUS CONSEQUENCE. CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	3	1	3
			MODE - MUSTARD SPILL DURING PUNCH OPERATION. CAUSE(S) A. BULK CONTAINER HOLDING FIXTURE NOT SECURE.	POTENTIAL DAMAGE SHUTDOWN AND MAINTENANCE IF MUSTARD-AIR MIXTURE REACHES EXPLOSIVE PROPORTIONS AND IGNITION SOURCE IS PRESENT.	TOXIC GAS RELEASE TO PRIMARY FUME BURNER.	FAILURE DETERRENCE PUNCH COLLAR DESIGNED TO FIT CLOSELY OVER CONTAINER AND THE COLLAR WILL BE VENTED TO THE PRIMARY FUME BURNER. TV MONITOR THROUGH VIEW PORT FOR PROPER POSITION OF COLLAR. DECON SOLUTION IS ALSO AVAILABLE IN LOADING AREA. MUSTARD SPILL AND THEN FORMATION OF AN EXPLOSIVE MIXTURE WITH AIR AND THEN AN EXPLOSION IS REGARDED AS EXTREMELY REMOTE. CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	3	1	3

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 5. METAL PARTS FURNACE (MPF)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
5.2	METAL PARTS FURNACE (VOLATILIZATION CHAMBER)	CONTROLLED VOLATILIZATION OF AGENT.	MODE - CONTAINER DAMAGED BY INNER OR OUTER DOORS. CAUSE(S) A. MECHANICAL FAILURE OF DOOR DRIVE MECHANISM AND INTERLOCK FAILURE.	EQUIPMENT SHUTDOWN AND MAINTENANCE. PERSONNEL POTENTIAL TOXIC (MUSTARD AGENT) RELEASE TO AFTERBURNER.	FAILURE DETERRENCE THE FURNACE DOORS ARE INTERLOCKED AND AUTOMATICALLY SEQUENCED. THE OCCURRENCE OF THIS MODE IS REGARDED AS EXTREMELY REMOTE. CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	2	1	2
	METAL PARTS FURNACE (VOLATILIZATION CHAMBER)	CONTROLLED VOLATILIZATION OF AGENT.	MODE - BURNER FLAME OUT. CAUSE(S) A. LINE BLOCKAGE (FILTER). B. LOSS OF COMBUSTION AIR DUE TO BLOWER FAILURE. C. FUEL SUPPLY TANK EMPTY.	SHUTDOWN AND MAINTENANCE.	FAILURE DETERRENCE ULTRAVIOLET FLAME SCANNER AND LOW TEMPERATURE ALARM PROVIDED AS ARE REDUNDANT FILTERS, FUEL PUMPS AND BLOWERS. A LOW LEVEL ALARM IS PROVIDED ON THE FUEL TANK. EMERGENCY SHUTDOWN CAPABILITY IS PROVIDED. CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	2	2	4

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL [X]

BUILDING BLOCK: NO. 5. METAL PARTS FURNACE (MPF)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
5.2	METAL PARTS FURNACE (VOLATILIZATION CHAMBER (CONTINUED)		MODE - TEMPERATURE TOO HIGH. CAUSE(S) A. FAILURE OF TEMPERATURE CONTROL SYSTEM, AND HIGH TEMPERATURE SHUTDOWN IS NOT INITIATED.	EQUIPMENT POTENTIAL DAMAGE TO EQUIPMENT SHUTDOWN AND MAINTENANCE.	FAILURE DETERRENCE HIGH TEMPERATURE ALARM PROVIDED. FOR VERY HIGH TEMPERATURE AN AUTOMATIC FOG SPRAY PURGE TO CHAMBER IS INITIATED. EMERGENCY SHUTDOWN CAPABILITY IS PROVIDED. CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	2	2	4
			MODE - FAILURE OF PURGE SYSTEM. CAUSE(S) A. LOSS OF STEAM AND PRESSURE SWITCH FAILS (LOSS OF PURGE FOR EMERGENCY SHUTDOWN AS WELL AS STEAM FOR BURNER OPERATION).	SHUTDOWN AND MAINTENANCE.	FAILURE DETERRENCE STEAM PRESSURE SWITCH INTERLOCKED WITH FURNACE OPERATION. EMERGENCY WATER SUPPLY PROVIDED. EMERGENCY SHUTDOWN CAPABILITY PROVIDED. CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	1	2	2

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 5. METAL PARTS FURNACE (MPF)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
5.2	METAL PARTS FURNACE (VOLATILIZATION CHAMBER) (CONTINUED)		MODE - DOOR TO PUNCH CHAMBER OPENS DURING VOLITIZATION AND MUSTARD AGENT/AIR MIXTURE FORMS. CAUSES A. OPERATOR OPENS DOOR IN ERROR AND INTERLOCK SYSTEM FAILS.	EQUIPMENT: DAMAGE SHUTDOWN AND MAINTENANCE. PERSONNEL: TOXIC RELEASE TO CHARCOAL FILTER SYSTEM SHOULD AN EXPLOSION OCCUR.	FAILURE DETERRENCE ALL DOORS ARE INTERLOCKED AND SEQUENCED. MANUAL SWITCHES ARE INOPERATIVE DURING THE AUTOMATIC OPERATION. THE OCCURRENCE OF THE MODE IS REGARDED AS EXTREMELY REMOTE. CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	3	1	3
5.3	METAL PARTS FURNACE (BURNOUT CHAMBER)	REMOVE RESIDUAL AGENT AND PROVIDE FINAL THERMAL TREATMENT FOR DETOXIFIED CONTAINER.	MODE - BURNER FLAME OUT. CAUSE(S) A. LINE BLOCKAGE (FILTER). B. LOSS OF COMBUSTION AIR DUE TO BLOWER FAILURE. C. FUEL SUPPLY TANK EMPTY.	SHUTDOWN AND MAINTENANCE.	FAILURE DETERRENCE ULTRAVILOET FLAME SCANNER AND LOW TEMPERATURE ALARM PROVIDED AS ARE REDUNDANT FILTERS, FUEL PUMPS AND BLOWERS. A LOW LEVEL ALARM IS PROVIDED ON THE FUEL TANK. EMERGENCY SHUTDOWN CAPABILITY IS PROVIDED. CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	1	1	1
			MODE - TEMPERATURE TOO HIGH. CAUSE(S) A. FAILURE OF TEMPERATURE CONTROL SYSTEM, AND HIGH TEMPERATURE SHUTDOWN IS NOT INITIATED.	POTENTIAL DAMAGE TO EQUIPMENT SHUTDOWN AND MAINTENANCE.	FAILURE DETERRENCE HIGH TEMPERATURE ALARM PROVIDED. FOR VERY HIGH TEMPERATURE AN AUTOMATIC FOG SPRAY PURGE TO CHAMBER IS INITIATED. EMERGENCY SHUTDOWN CAPAVILITY IS PROVIDED. CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	2	1	2

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [ ]
COMPONENT LEVEL [X]

BUILDING BLOCK: NO. 5. METAL PARTS FURNACE (MPF)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL		FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
				EQUIPMENT	PERSONNEL				
5.4	PRIMARY FUME BURNER * AUXILIARY FUME BURNER	INCINERATION OF FUMES FROM THE METAL PARTS FURNACE.	MODE - FLAME EXTINGUISHED CAUSE A. FUEL BLOCKAGE B. COMBUSTION AIR LOSS (BLOWER FAILURE) C. FUEL SUPPLY INSUFFICIENT (TANK FILL PROBLEM).	SHUTDOWN MAINTENANCE.	MINOR TOXIC VAPOR RELEASE TO CAUSTIC SCRUBBER SECTION IF AUXILIARY BURNER FAILS. (IF PRIMARY BURNER FAILS, THE AUXILIARY BURNER WOULD ACT AS REDUNDANT BACK-UP.)	FAILURE DETERRENCE * ULTRAVIOLET FLAME SCANNER AND LOW TEMPERATURE ALARM WITH INTERLOCK TO SHUTDOWN. DOUBLE FILTERS TO PRECLUDE LINE BLOCKAGE. REDUNDANT BLOWERS. OXYGEN ANALYZER PROVIDED FOR COMBUSTION CONTROL. LEVEL ALARM IN FUEL TANKS. EMERGENCY SHUTDOWN CAPABILITY PROVIDED. THIS MODE OF FAILURE IS REGARDED AS EXTREMELY REMOTE. CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	2	1	2
			MODE - TEMPERATURE TOO HIGH. CAUSE TEMPERATURE CONTROL SYSTEM FAILS AND HIGH TEMPERATURE SHUTDOWN IS NOT INITIATED.	POTENTIAL DAMAGE TO EQUIPMENT SHUTDOWN AND MAINTENANCE.		FAILURE DETERRENCE ULTRAVIOLET FLAME SCANNER AND HIGH TEMPERATURE ALARM PROVIDED. STEAM ADDITION TO VOLATILIZATION CHAMBER FOR VERY HIGH TEMPERATURE, AN AUTOMATIC FOG SPRAY PURGE IS APPLIED TO VOLITIZATION CHAMBER AND EMERGENCY FURNACE SHUTDOWN IS INITIATED. CORRECTIVE ACTION NONE RECOMMENDED.	3	1	3
			MODE - TEMPERATURE TOO LOW. CAUSE TEMPERATURE CONTROL SYSTEM FAILS AND LOW TEMPERATURE SHUTDOWN IS NOT INITIATED.		MINOR TOXIC VAPOR RELEASE TO CAUSTIC SCRUBBER SECTION IF FAILURE IS IN AUXILIARY BURNER. (IF FAILURE IS IN PRIMARY BURNER, THE AUXILIARY BURNER WOULD ACT AS REDUNDANT BACK-UP.)	FAILURE DETERRENCE * ULTRAVIOLET FLAME SCANNER AND LOW TEMPERATURE ALARM PROVIDED. STEAM ADDITION TO VOLATILIZATION CHAMBER FOR VERY LOW TEMPERATURE, AN AUTOMATIC FOG SPRAY PURGE IS APPLIED TO VOLATILIZATION CHAMBER AND EMERGENCY FURNACE SHUTDOWN IS INITIATED. CORRECTIVE ACTION NONE RECOMMENDED.	2	2	4

*NOTE: THE PRIMARY AND AUXILIARY FUME BURNERS ACT AS A SERIES REDUNDANT BURNER SYSTEM.

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 5. METAL PARTS FURNACE (MPF)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
5.5	QUENCH TOWER	SUPER SATURATION OF HOT FLUE GASES FROM SLAGGING AFTERBURNER PRIOR TO ENTERING VENTURI SCRUBBER.	MODE - HIGH QUENCH ZONE TEMPERATURE. CAUSE(S) A. INLET PUMP OR CONTROL VALVE FAILS AND OPERATOR FAILS TO TAKE ACTION.	EQUIPMENT POSSIBLE TOWER DAMAGE.	FAILURE DETERRENCE HIGH TEMPERATURE ALARM - AUTO SYSTEM SHUTDOWN PROVIDED	3	1	3
			B. QUENCH MAKEUP WATER VALVE FAILS AND OPERATOR FAILS TO TAKE ACTION.	POSSIBLE TOWER DAMAGE.	LOW PRESSURE AND FLOW ALARM. REMOTE MANUALLY OPERATED REDUNDANT VALVE PROVIDED. REMOTE MANUAL VALVE WITH EMERGENCY WATER SUPPLY. CORRECTIVE ACTION NONE RECOMMENDED.			
			MODE - EMPTY QUENCH TOWER. CAUSE(S) LEVEL CONTROL VALVE IN DOWNSTREAM SCRUBBER TOWER FAILS OR QUENCH BRINE PUMP (P-302) FAILS, OR CONTROL VALVE FAILS.	POSSIBLE TOWER DAMAGE (LOSS OF FLOW TO QUENCH TOWER AND VENTURI SCRUBBER).	FAILURE DETERRENCE LOW LEVEL AND FLOW ALARMS ARE PROVIDED FOR BOTH THE QUENCH TOWER AND VENTURI SCRUBBER. (THE SCRUBBER TOWER ALSO HAS FIVE LEVEL ALARMS AND A PRESSURE ALARM.) IN ADDITION A TEMPERATURE SWITCH (VENTURI SCRUBBER FLUE GAS OUTLET) WOULD INITIATE EMERGENCY WATER FLOW FROM THE 3099-GALLON HEAD TANK. FINALLY, AUTOMATIC FURNACE AND AFTERBURNER SHUTDOWN WOULD BE INITIATED. CORRECTIVE ACTION NONE RECOMMENDED.	3	1	3

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 5. METAL PARTS FURNACE (MPF)

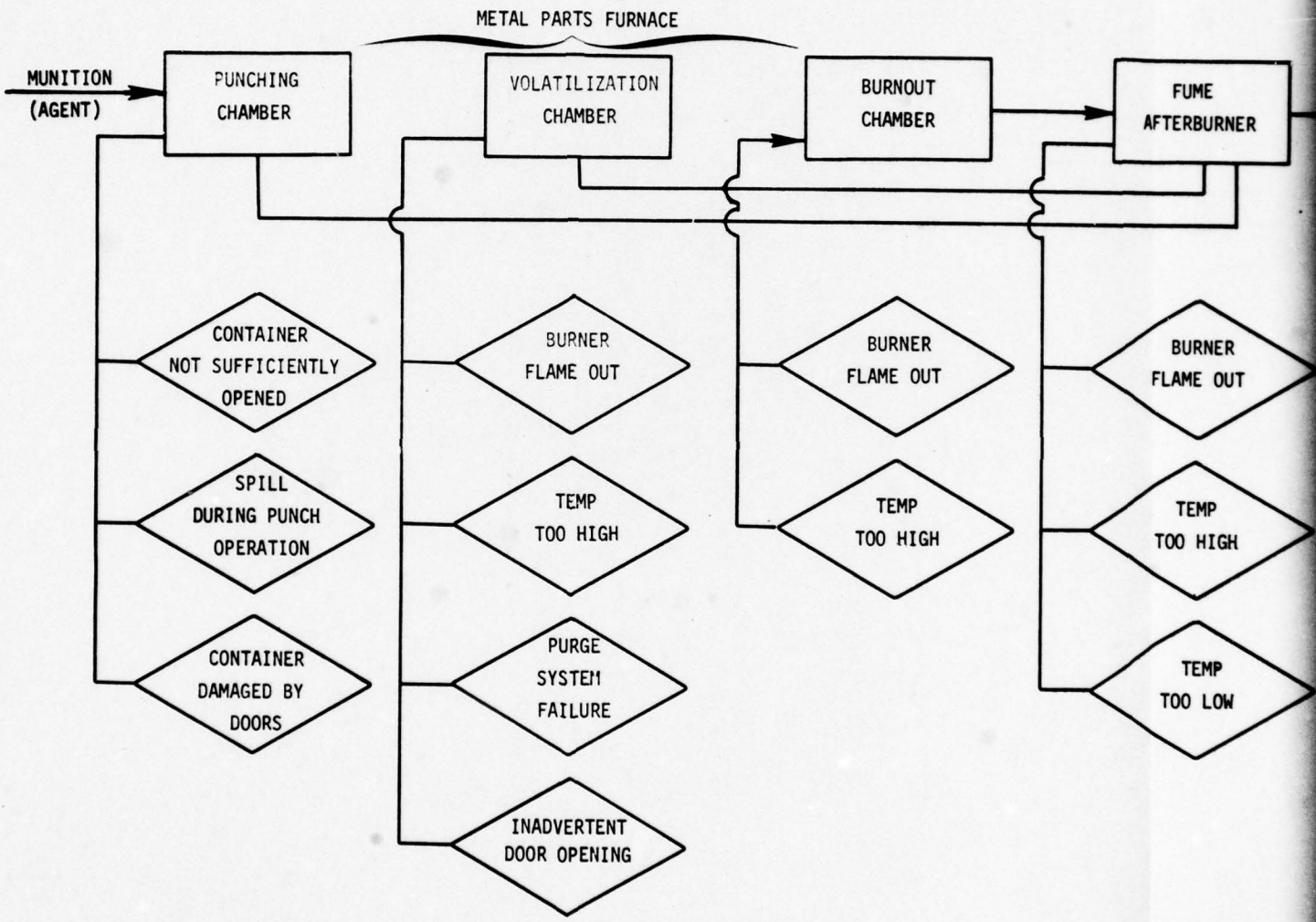
	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL		FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
5.6	VENTURI SCRUBBER	PARTICULATE COLLECTION AND CHEMICAL SCRUBBING.	MODE - LOSS OF BRINE FLOW TO VENTURI. CAUSE(S) A. VENTURI BRINE PUMP (FLOW FROM SCRUBBER TOWER) FAILS (LOSS OR REDUCED SCRUBBING ACTION). B. REMOTE FLOW CONTROLLER FAILURE.	EQUIPMENT	PERSONNEL POSSIBILITY OF RELEASE OF GASES TO CAUSTIC SCRUBBER. POSSIBILITY OF RELEASE OF GASES TO CAUSTIC SCRUBBER.	FAILURE DETERRENCE AUTO OPEN BYPASS VALVE & LEVEL CONTROL VALVE. LOW PRESSURE ALARM. HIGH TEMPERATURE ALARM WITH AUTO SHUTDOWN OR FURNACE AND AFTERBURNER. LOW FLOW ALARM. MANUAL FLOW ADJUSTMENT PROVIDED. HIGH TEMPERATURE ALARM WITH AUTO SHUTDOWN OF FURNACE AND AFTERBURNER. CORRECTIVE ACTION NONE RECOMMENDED.	2	1	2
			MODE - VENTURI THROAT PLUG MISALIGNMENT. CAUSE(S) A. THROAT PLUGGED OR CLOSED DUE TO MALFUNCTION OF ELECTRICAL DIFFERENTIAL PRESSURE CONTROLLER CAUSING FURNACE OVERPRESSURIZATION. B. THROAT OPEN TOO FAR DUE TO PRESSURE CONTROLLER MALFUNCTION LOSS OR REDUCED SCRUBBING ACTION.	SHUTDOWN AND MAINTENANCE SHUTDOWN AND MAINTENANCE	POSSIBLE TOXIC RELEASE TO CAUSTIC SCRUBBER AND FURNACE HOUSING (6 AIR CHANGE AREAS THRU CHARCOAL FILTERS)	FAILURE DETERRENCE HIGH DIFFERENTIAL PRESSURE ALARM. PROVISION FOR MANUAL CONTROL OF THROAT PLUG. AUTOMATIC SHUTDOWN OF FURNACE AND AFTERBURNER. LOW DIFFERENTIAL PRESSURE ALARM. PROVISION FOR MANUAL CONTROL OF THROAT PLUG. CORRECTIVE ACTION NONE RECOMMENDED.	2	1	2

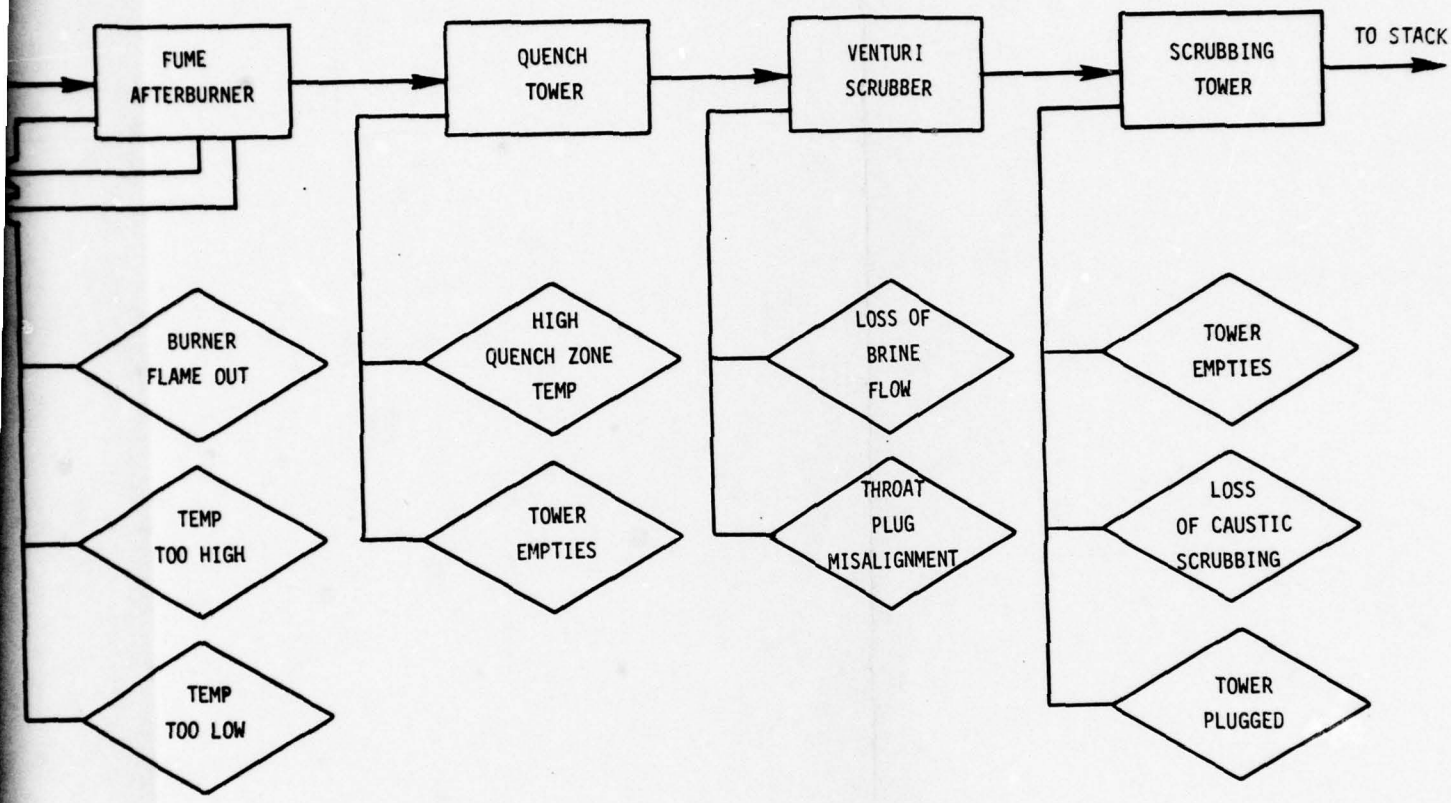
FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☑

BUILDING BLOCK: NO. 5. METAL PARTS FURNACE (MPF)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL		FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
5.7	SCRUBBING TOWER	TO REMOVE FLUE GAS CONTAMINANTS THAT REQUIRE LONGER CONTACT TIMES.	MODE - TOWER EMPTIES. CAUSE(S) A. FAILURE OPEN OF LEVEL CONTROL VALVE AND AUTO SHUTDOWN SYSTEM FAILS.	EQUIPMENT POTENTIAL EQUIPMENT DAMAGE. SHUTDOWN AND MAINTENANCE.	PERSONNEL	FAILURE DETERRENCE LOW LEVEL ALARM AND AUTO SHUTDOWN PROVIDED (FURNACE AND AFTERBURNER AUTO DE-ENERGIZE LEVEL CONTROL VALVE.) CORRECTIVE ACTION NONE REQUIRED.	2	1	2
			MODE - LOSS OF CAUSTIC SCRUBBING CAPABILITY. CAUSE(S) A. CAUSTIC PUMP FAILURE AND OPERATOR FAILS TO TAKE ACTION. B. pH CONTROL FAILURE AND OPERATOR FAILS TO TAKE ACTION.	SHUTDOWN AND MAINTENANCE.	EMISSION STANDARDS MAY BE EXCEEDED (BUT NOT AGENT).	FAILURE DETERRENCE LOW PRESSURE ALARM ON PUMP (ALSO MANUAL SWITCH CAPABILITY TO A STANDBY PUMP IS PROVIDED) LOW pH ALARM PROVIDED. MANUALLY ADJUST CONTROL VALVE. CORRECTIVE ACTION NONE REQUIRED.	2	1	2
			MODE - TOWER PLUGGED. CAUSE(S) A. DEMISTER AND/OR PACKED SECTION PLUGGED - REDUCED GAS FLOW AND FURNACE/AFTERBURNER OVERPRESSURIZATION. OPERATOR FAILS TO TAKE ACTION.	SHUTDOWN AND MAINTENANCE.	EMISSION STANDARDS MAY BE EXCEEDED (BUT NOT AGENT).	FAILURE DETERRENCE HIGH DIFFERENTIAL PRESSURE ALARM TO SAFE MODE CONDITION (MANUALLY INITIATE FURNACE AND AFTERBURNER SHUTDOWN IF ΔP TOO HIGH). CORRECTIVE ACTION NONE REQUIRED.	2	1	2
			MODE - TOWER OVERFILLS. CAUSE(S) A. PLUGGED PURGE PUMP SUCTION OR LEVEL CONTROL VALVE FAILURE.			FAILURE DETERRENCE MANUALLY PURGE SUCTION LINE. AUTO SHUTDOWN OF FURNACE AND AFTERBURNER. CORRECTIVE ACTION NONE REQUIRED.	2	1	2


METAL PARTS FURNACE
MUNITION
(AGENT)
PUNCHING CHAMBER
VOLATILIZATION CHAMBER
BURNOUT CHAMBER
FUME AFTERBURNER
CONTAINER NOT SUFFICIENTLY OPENED
SPILL DURING PUNCH OPERATION
CONTAINER DAMAGED BY DOORS
BURNER FLAME OUT
TEMP TOO HIGH
PURGE SYSTEM FAILURE
INADVERTENT DOOR OPENING
BURNER FLAME OUT
TEMP TOO HIGH
BURNER FLAME OUT
TEMP TOO HIGH
TEMP TOO LOW



NO. 5. METAL PARTS FURNACE (MPF)

FMEA INFORMATION SOURCES

BB No. 5 METAL PARTS FURNACE

DRAWINGS/DOCUMENTS:

Draft Demil Plan for CAMDS

Hercules, Inc. series of FMEHA Reports

Final Concept Design Report - Metal Parts Furnace and Concept Design Changes

Available E.A. subcontractor drawings

PERSONNEL REFERENCED:

Edgewood Arsenal personnel discussions - J. Bartel, R. Misiewicz, R. Roux, et al.

Surface Combustion personnel - F. Rinker

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [X]
COMPONENT LEVEL [X]

BUILDING BLOCK: NO. 6. ROCKET DEMIL MACHINE (RDM)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
6.0	ROCKET DEMIL MACHINE (RDM)	THE RDM IS USED TO DRAIN THE AGENT FROM THE ROCKET WARHEAD AND TO CUT THE ROCKET INTO SECTIONS SMALL ENOUGH TO PROCESS THROUGH THE DEACTIVATION FURNACE. DURING OPERATION THE RDM IS INSTALLED WITHIN THE EXPLOSIVE CONTAINMENT CUBICLE (ECC).		EQUIPMENT				
6.1	FUNCTIONALLY INTERFACING BUILDING BLOCKS							
	BB NO. 2 ECC	EXPLOSIVE CONTAINMENT CUBICLE						
	BB NO. 9 FHM	HYDRAULIC PRESSURE SUPPLY						
	BB NO. 22 MHE	ROCKET ECC INPUT CONVEYOR, RDM INPUT CONVEYOR, ROCKET ECC DISCHARGE AND SEGREGATING CONVEYOR)						
	BB NO. 30 CTV	REMOTE VISUAL MONITOR						
	BB NO. 31 COM	REMOTE AUDIO MONITOR						
	BB NO. 14 ETS	DECON SOLUTION AND WASTE TREATMENT						
	BB NO. 13 ADS	AGENT DESTRUCTION						
6.2	ROCKET ECC INPUT CONVEYOR	RECEIVE MUNITION FROM UNPACK AREA PERSONNEL. EXTENDS INTO THE ECC AND MATES WITH AN INTERMEDIATE CONVEYOR OR THE DEMIL MACHINE, TRANSPORT THE MUNITION TO THE NEXT HARDWARE ITEM, AND RETRACTS TO CLEAR THE ECC, ALLOWING ITEM IN DOOR CLOSURE.	MODE - MUNITIONS LOADED BACKWARDS BY UNPACK AREA PERSONNEL. CAUSE(S) A. HUMAN ERROR.	MUNITIONS LINE INTERRUPTION WHILE ERROR IS CORRECTED.	FAILURE DETERRENCE A CONVEYOR MOUNTED SENSOR DETECTS PROPER ORIENTATION.	1	4	4

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

(ROM)

BUILDING BLOCK: NO. 6. ROCKET DEMIL MACHINE

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
6.2	ROCKET ECC INPUT CONVEYOR (CONTINUED)		MODE - FAILURE OF THE CONVEYOR TO MOVE IN THE ECC AND MATE WITH THE INTERMEDIATE CONVEYOR OR DEMIL MACHINE. CAUSE(S) A. FAILURE OF THE CONVEYOR POSITIONING MECHANISM.	EQUIPMENT FAILURE TO MATE CORRECTLY WILL NOT ALLOW THE NEXT STEP IN THE PROCESS TO BEGIN.	FAILURE DETERRENCE LIMIT SWITCHES INDICATE PROPER ALIGNMENT AND MATING.	1	4	4
			MODE - FAILURE TO CONVEY MUNITION. CAUSE(S) A. ACTUATION MOTOR FAILURE.	MUNITIONS LINE INTERRUPTION WHILE FAILURE IS CORRECTED.	FAILURE DETERRENCE DOWNSTREAM CONVEYOR DETECTS ARRIVAL OF MUNITION WITH SENSORS INSURING DETECTION OF MOTOR FAILURE.	1	4	4
			MODE - FAILURE OF CONVEYOR TO RETRACT FROM THE ECC. CAUSE(S) A. FAILURE OF THE CONVEYOR POSITIONING MECHANISM	FAILURE TO RETRACT CORRECTLY WILL NOT ALLOW THE NEXT STEP IN THE PROCESS TO BEGIN.	FAILURE DETERRENCE LIMIT SWITCHES INDICATE PROPER RETRACTION.	1	4	4
			MODE - POSSIBLE CONTAMINATION OF THE CONVEYOR AT THE INTERMEDIATE CONVEYOR OR DEMIL MACHINE CONTACT POINT.	CONTAMINATED HARDWARE (CONVEYORS) ARE RETRACTED INTO THE UNPACK AREA (AIRLOCK).	FAILURE DETERRENCE THE AIRLOCK AREA IS MAINTAINED AT A NEGATIVE PRESSURE RELATIVE TO THE BALANCE OF THE UNPACK AREA. AGENT SENSORS ARE LOCATED IN THE UNPACK AREA. STANDARD OPERATING PROCEDURES FOR PERSONNEL MINIMIZE POTENTIAL FOR EXPOSURE.	2	4	8

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

(RDM)

BUILDING BLOCK: NO. 6. ROCKET DEMIL MACHINE

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
6.2	ROCKET ECC INPUT CONVEYOR (CONTINUED)	POWERED ROLLERS AND PUSH CYLINDER(S) MOVE MUNITIONS TO DEMIL STATIONS.	MODE - POWERED ROLLER FAILURE. CAUSE(S) A. ELECTRIC MOTOR FAILURE.	EQUIPMENT MUNITION LINE INTERRUPTION UNTIL FAILURE IS CORRECTED.	FAILURE DETERRENCE THE CONVEYOR OR MACHINE HAS A SENSOR TO DETECT PROPER TRANSFER OF THE MUNITION TO THE RDM. MOTOR FAILURE WOULD BE DETECTED BY THE ABSENCE OF THIS TRANSFER, HALTING THE DEMIL PROCEDURE.	1	4	4
			MODE - PUSH CYLINDER FAILURE. CAUSE(S) A. HYDRAULIC FAILURE.	MUNITION LINE INTERRUPTION UNTIL FAILURE IS CORRECTED.	FAILURE DETERRENCE LIMIT SWITCHES SENSE BOTH EXTENDED AND RETRACTED PUSH CYLINDER POSITIONS.	1	4	4
		POSITION ROCKET FOR PUNCH AND DRAIN.	MODE - FAILURE OF CONVEYOR TO POSITION ROCKET IN PROPER PUNCH AND DRAIN LOCATION.	PUNCH HOLES WOULD NOT BE IN THE SPECIFIED LOCATION TO ALLOW PROPER AGENT DRAINAGE.	FAILURE DETERRENCE THE ROCKET IS MOVED INTO POSITION BY THE CONVEYOR. MOVEMENT IS STOPPED WHEN THE ROCKET BAND STRIKES THE ROLLER ON THE SAW TANK. A BACKUP STOP IS PROVIDED BY THE NUMBER 5 SAW CLAMPS WHICH ARE CLOSED DURING THE POSITIONING SEQUENCE. THE ROCKET IS PREVENTED FROM "BOUNCING" BACK BY THE LAST ROLLER ON THE INPUT CONVEYOR. THERE IS ALMOST 5 INCHES OF POSSIBLE AXIAL MOVEMENT. HOWEVER, THERE IS APPROXIMATELY 1 FOOT OF AGENT CAVITY ON EITHER SIDE OF THE PLANNED PUNCH POINT. A MICROSWITCH SENSES IF THE ROCKET IS IN THE PROPER POSITION. THE COMPUTER CONTROL SYSTEM AUTOMATICALLY HALTS RDM OPERATIONS AND ALL PRECEDING FUNCTIONS, WHEN THE ROCKET IS IMPROPERLY POSITIONED.	1	2	2

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

(RDM)

BUILDING BLOCK: NO. 6. ROCKET DEMIL MACHINE

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
6.3	PUNCH CLAMP	HOLDS THE ROCKET IN POSITION FOR PUNCHING.	MODE - FAILURE OF PUNCH CLAMP TO SECURE ROCKET.	EQUIPMENT PUNCH HOLES COULD BE IN WRONG PLACE AND SUBSEQUENT MOVEMENT COULD PREVENT PROPER DRAINING	FAILURE DETERRENCE A MICROSWITCH SENSES IF THE CLAMP IS IN THE PROPER POSITION. THE COMPUTER CONTROL SYSTEM AUTOMATICALLY HALTS RDM OPERATIONS AND ALL PRECEDING FUNCTIONS WHEN THE CLAMP IS IMPROPERLY POSITIONED.	1	2	2
			MODE - FAILURE OF PUNCH CLAMP TO RELEASE AT COMPLETION OF DRAIN.	THE ROCKET CANNOT PROCEED TO THE NEXT STATION.	FAILURE DETERRENCE SEE ENTRY ABOVE.	1	2	2
6.4	PUNCHES	PUNCH HOLES IN THE ROCKET TO ALLOW AGENT DRAINING.	MODE - FAILURE OF PUNCHES TO OPERATE OR COMPLETELY PIERCE ROCKET.	AGENT DRAINING CANNOT BE ACCOMPLISHED. SUBSEQUENT SAWING WOULD RESULT IN AGENT DRAINING INTO THE DECON TANK.	FAILURE DETERRENCE THE DIFFERENTIAL PRESSURE SWITCH INDICATES WHEN/IF DRAINING IS COMPLETE. IT WILL ALSO INDICATE IF/WHEN NO DRAINING HAS OCCURRED. THE SWITCH POSITION IS TIED INTO THE COMPUTER SYSTEM WHICH WOULD AUTOMATICALLY HALT RDM OPERATIONS IN THE EVENT OF THIS FAILURE.	1	2	2
			MODE - FAILURE OF PUNCHES TO RETRACT AFTER PIERCING THE ROCKET.	POTENTIAL DAMAGE TO THE PUNCHES AND/OR ACTUATOR IF ATTEMPT IS MADE TO MOVE ROCKET TO THE NEXT STATION. NOTE THE PUSH ROD OPERATES FROM 100 PSI WITH A 1½-INCH BORE (=175 LB FORCE).	FAILURE DETERRENCE A MICROSWITCH SENSES IF THE PUNCH "OUT STROKE" MOVEMENT HAS OCCURRED. THE SWITCH POSITION IS TIED INTO THE COMPUTER SYSTEM WHICH WOULD AUTOMATICALLY HALT RDM OPERATIONS IN THE EVENT OF THIS FAILURE.	1	2	2

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL [X]

(RDM)

BUILDING BLOCK: NO. 6. ROCKET DEMIL MACHINE

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
6.5	PUSH CYLINDER	MOVES ROCKET TO SAW POSITION.	MODE - PUSHROD DOES NOT TRAVEL FULL STROKE. CAUSE(S) A. LACK OF SUFFICIENT HYDRAULIC PRESSURE.	EQUIPMENT THE ROCKET WILL NOT BE SECTIONED AT THE PRESCRIBED POINTS. SECTIONED ROCKETS WOULD BE THE WRONG SIZE FOR THE FURNACE, AND THE POSSIBILITY EXISTS THAT ALL SECTIONS WOULD NOT BE HELD BY THE CLAMPS, PERMITTING SOME TO DROP INTO THE SAW TANK.	FAILURE DETERRENCE A PUSHCYL. MOVES THE ROCKET UNTIL THE ROCKET RING CATCHES ON A SADDLE. (THIS IS ALSO THE END OF THE PUSHCYL. STROKE.) A LIMIT SWITCH INDICATES IF THE ROCKET HAS MOVED FAR ENOUGH. IF THE SWITCH DOES NOT SO INDICATE, THE COMPUTER SYSTEM WILL AUTOMATICALLY HALT RDM OPERATIONS BEFORE SAWING CAN BEGIN. NOTE: THE POSITIONING SADDLE AND THE PUSHCYL. BOTH OPERATE FROM THE SAME HYDRAULIC VALVE SO THAT IF THE SADDLE DID NOT POSITION TO CATCH THE ROCKET THE PUSHCYL. WOULD NOT MOVE THE ROCKET ANYWAY. (THIS ASSURES THAT THE ROCKET WILL NOT BE PUSHED BEYOND THE LIMIT POINT.) THE ECC DISCHARGE AND SEGREGATING CONVEYOR CAT WHISKER LIMIT SWITCHES MIGHT DETECT SEGMENTS WHICH HAVE BEEN SECTIONED IMPROPERLY.	1	2	2
6.6	SAW CLAMPS	CLAMPS AND HOLDS ROCKET FOR STAKING AND SAWING.	MODE - FAILURE TO CLAMP AND HOLD PROPERLY	SAWING OPERATIONS COULD RESULT IN MECHANICAL DAMAGE TO THE EQUIPMENT (SAW BLADE BINDING OF BREAKAGE, ETC.).	FAILURE DETERRENCE THERE WOULD BE NO INDICATION IF ANY OR ALL OF THE CLAMPS DO NOT CLOSE. WORSE CASE WOULD OCCUR IF EHM VALVE V3 REMAINS CLOSED, SINCE IT CONTROLS MORE OF THE CLAMPS THAN ANY OTHER VALVE. MONITORING OF THE INDIVIDUAL SAW MOTOR CURRENT WOULD INDICATE A BROKEN OR JAMMED SAW BLADE. THIS WOULD RESULT IN SHUTDOWN OF THE RDM LINE. IMPROPER SAWING RESULTING IN ONLY MISPLACEMENT OF A SEGMENT WOULD NOT BE EVIDENT UNTIL SENSING (COUNTING) BY CAT WHISKER LIMIT SWITCHES IN THE SEGREGATOR TRAY SO INDICATED.	2	2	4

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

(RDM)
BUILDING BLOCK: NO. 6. ROCKET DEMIL MACHINE

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
6.7	STAKER	THE STAKER DIMPLES THE ROCKET CASE TO HOLD THE PROPELLANT POSITIONING SPRING IN A COMPRESSED POSITION.	MODE - STAKER FAILS TO IMPALE (DIMPLE) THE ROCKET CASE. MAY ALLOW SUBSEQUENT MOVEMENT OF THE PROPELLANT AFTER SAWING.	EQUIPMENT SUBSEQUENT TO SAWING, THE EXPANDING SPRING COULD INTERLOCK THE PROPELLANT SEGMENTS, ALLOWING TOO MUCH PROPELLANT INTO A FURNACE AT ONCE IF NOT CORRECTED.	FAILURE DETERRENCE THERE IS NO IMMEDIATE FEEDBACK TO INDICATE IF THE STAKER PROPERLY DIMPLES THE ROCKET CASE. HOWEVER, INTERLOCKED PROPELLANT SEGMENTS WOULD BECOME EVIDENT AT THE SEGREGATOR CONVEYOR WHERE CAT WHISKER LIMIT SWITCHES ARE USED TO SENSE (COUNT) THE SEGMENTS. INDICATION OF AN IMPROPER SEGMENT COUNT WOULD RESULT IN AUTOMATIC SHUTDOWN OF THE RDM BY THE CONTROL SYSTEM.	1	4	4
6.8	CARRIAGE	MOVABLE MOUNTING PLATFORM FOR THE SAW IDLER ROLLERS (4), ROCKET CLAMPS (7) AND IMPALING PUNCHES (ON SECOND SET OF CLAMPS), IMPALING PUNCHES (ADJACENT TO THE FOURTH SET OF CLAMPS), AND MOTOR-DRIVEN RADIAL SAWS (6). THE CARRIAGE LOWERS THESE COMPONENTS WITH THE CLAMPED ROCKET INTO THE SLUDGE TANK CONTAINING DECON SOLUTION PRIOR TO SAWING.	MODE - FAILURE OF THE CARRIAGE TO LOWER PRIOR TO SAWING OR TO RAISE AFTER SAWING.	SAWING OPERATIONS PRIOR TO CARRIAGE LOWERING COULD RESULT IN FIRE/EXPLOSIONS.	FAILURE DETERRENCE LIMIT SWITCHES INDICATE WHEN THE CARRIAGE IS IN THE FULLY LOWERED OR RAISED POSITIONS. THE CONTROL CENTER WILL NOT ALLOW THE SAWING STEP TO TAKE PLACE UNLESS AN INDICATION IS RECEIVED THAT THE CARRIAGE IS FULLY LOWERED.	2	2	4
6.9	TANK CONTAINING DECON SOLUTION	THE SAW TANK SOLUTIONS FOR GB AND VX ROCKETS SUPPRESS SPARKS AND COOL THE BLADES DURING THE SAWING OPERATION. THE SAW TANK SOLUTION USED WITH VX ROCKETS WILL NOT DECONTAMINATE THE ROCKETS.	MODE - LOW SOLUTION LEVEL IN THE TANK. CAUSE(S) A. AN UPSTREAM VALVE FAILURE.	A FIRE/EXPLOSION MAY RESULT FROM HEAT BUILDUP DURING CUTTING.	FAILURE DETERRENCE THE TANK CONTAINS LEVEL SENSORS. A LOW LEVEL INDICATION AUTOMATICALLY SHUTS DOWN THE RDM OPERATION.	1	2	2

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL [X]

(RDM)
BUILDING BLOCK: NO. 6. ROCKET DEMIL MACHINE

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
6.10	RADIAL SAWS (6)	THE SIX RADIAL SAWS SECTION THE ROCKET AT PREDETERMINED POINTS PRODUCING SEVEN ROCKET SEGMENTS.	MODE - FAILURE OF THE SAWS TO SAW OR COMPLETELY SAW THE ROCKET. CAUSE(S) A. SAW BLADE FAILURE, MOTOR FAILURE, ETC.	EQUIPMENT ONE OR MORE EXCESSIVELY LARGE ROCKET SEGMENTS WOULD BE PRODUCED. THESE SEGMENTS UNDETECTED AND UNCORRECTED COULD ALLOW TOO MUCH PROPELLANT INTO A FURNACE AT ONCE.	FAILURE DETERRENCE MONITORING OF THE INDIVIDUAL SAW MOTOR CURRENTS WOULD INDICATE IMPROPER SAW OPERATION. SENSING (COUNTING) BY LIMIT SWITCHES IN THE SEGREGATOR TRAY WOULD DETECT A LARGE ROCKET SEGMENT BY INDICATING THAT A SEGMENT WAS MISSING.	2	2	4
6.11	SAW CLAMPS	RELEASE THE ROCKET SEGMENTS AT THE PROPER TIME, ALLOWING THEM TO FALL INTO THE MOVABLE TRAY OF THE ECC DISCHARGE AND SEGREGATING CONVEYOR (BB NO. 22).	MODE - FAILURE TO RELEASE THE ROCKET SEGMENT AT THE PRESCRIBED TIME CAUSED BY INADEQUATE CLAMP PRESSURE (PRE-RELEASE) OR STICKING (FAIL TO RELEASE). THE STAKED BURSTER SEGMENT OR THE PROPELLANT STAKED SEGMENT COULD POSSIBLY STICK.	THE CORRECT NUMBER OF SEGMENTS (LESS THAN THE CORRECT NUMBER) WILL NOT BE CONTAINED IN THE TRAY. THE IMMEDIATE EFFECT WOULD NOT BE SERIOUS EVEN IF UNDETECTED. THE SEGMENT COULD FALL IN THE DECON TANK, REQUIRING MANUAL REMOVAL.	FAILURE DETERRENCE SWITCHES ON THE SEGREGATOR WOULD DETECT THE ERROR IF THE PRESCRIBED NUMBER OF ROCKET SEGMENTS WERE NOT PRESENT AND WOULD SUBSEQUENTLY SHUTDOWN THE RDM OPERATION.	1	2	2
6.12	ROCKET ECC DISCHARGE AND SEGREGATING CONVEYOR	EXTENDS INTO THE ECC AND MATES WITH AN INTERMEDIATE CONVEYOR OR THE DEMIL MACHINE, TRANSPORTS THE MUNITION COMPONENTS TO THE NEXT CONVEYOR, AND RETRACTS TO CLEAR THE ECC, ALLOWING ITEM OUT DOOR CLOSURE. ALSO SEGREGATES PORTIONS OF THE MUNITIONS.	MODE - FAILURE OF THE CONVEYOR TO MOVE IN THE ECC AND MATE WITH THE INTERMEDIATE CONVEYOR OR DEMIL MACHINE. CAUSE(S) A. FAILURE OF THE CONVEYOR POSITIONING MECHANISM.	FAILURE TO MATE CORRECTLY WILL NOT ALLOW THE NEXT STEP IN THE PROCESS TO BEGIN.	FAILURE DETERRENCE LIMIT SWITCHES INDICATE PROPER ALIGNMENT AND MATING.	1	4	4

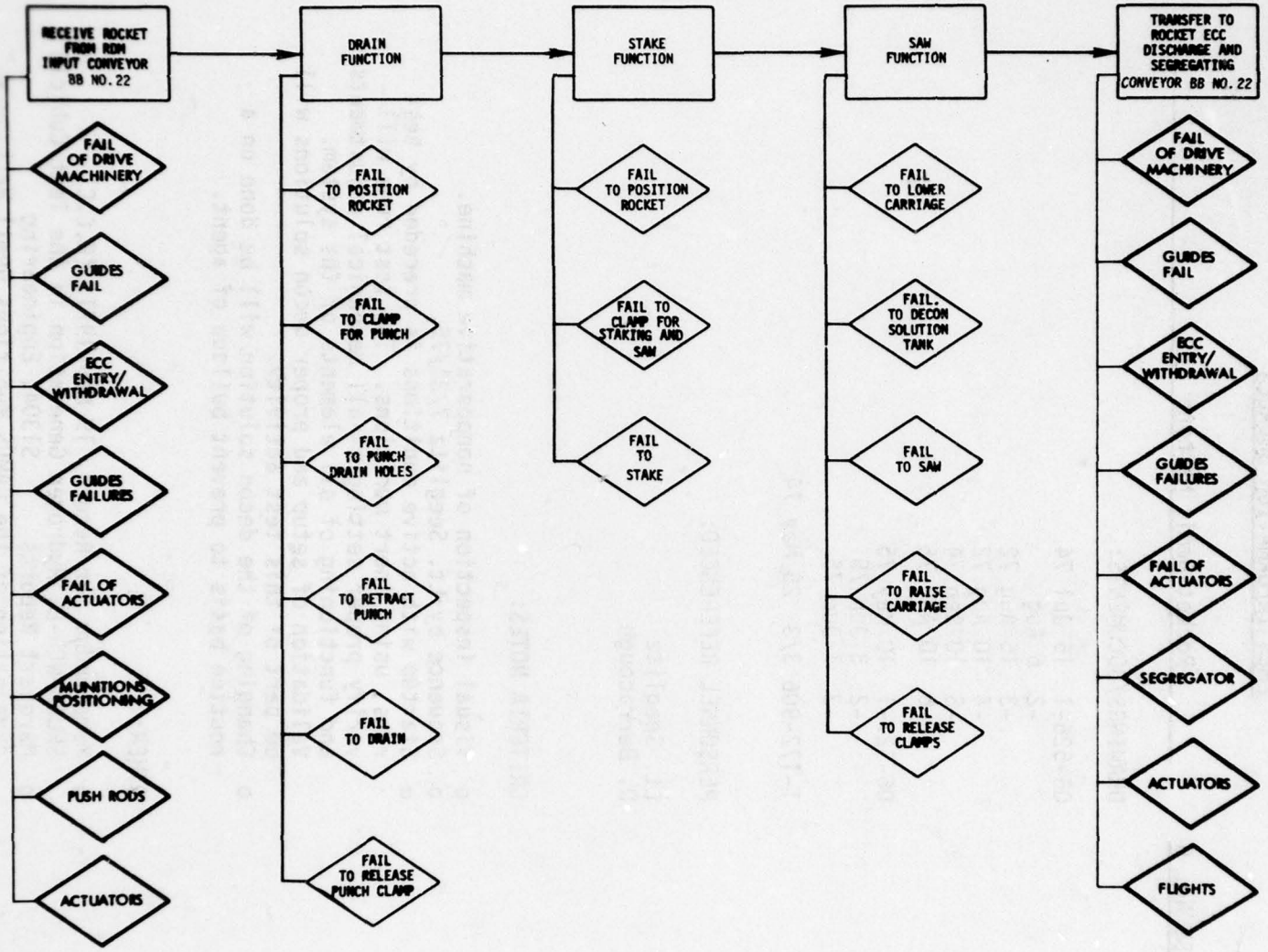
FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

(RDM)

BUILDING BLOCK: NO. 6. ROCKET DEMIL MACHINE

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL		FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
6.12	ROCKET ECC DISCHARGE AND SEGREGATING CONVEYOR (CONTINUED)		MODE - FAILURE TO CONVEY MUNITION. CAUSE(S) A. ACTUATION MOTOR FAILURE.	EQUIPMENT MUNITIONS LINE INTERRUPTION WHILE ERROR IS CORRECTED.	PERSONNEL	FAILURE DETERRENCE CONVEYOR HAS A SENSOR TO DETECT MOTION (REFERENCE BB NO. 35 SCS).	1	4	4
			MODE - FAILURE OF CONVEYOR TO RETRACT FROM THE ECC. CAUSE(S) A. FAILURE OF THE CONVEYOR POSITIONING MECHANISM.	FAILURE TO RETRACT CORRECTLY WILL NOT ALLOW THE NEXT STEP IN THE PROCESS TO BEGIN.		FAILURE DETERRENCE LIMIT SWITCHES INDICATE PROPER RETRACTION.	1	4	4
			MODE - THE ROCKET ECC DISCHARGE AND SEGREGATING CONVEYOR FAILURE TO SEGREGATE SEGMENTS OF THE ROCKET.	FAILURE TO SEGREGATE SEGMENTS OF THE ROCKET PRIOR TO ENTRY IN DEACTIVATION FURNACE COULD CAUSE AN EXPLOSIVE INDIDENT IN THE FURNACE.		FAILURE DETERRENCE SWITCHES INDICATE THE SEGREGATION OF EACH PIECE TO THE DEACTIVATION FURNACE INPUT CONVEYOR.	2	4	8
			MODE - POTENTIAL FIRE FROM EXPLOSIVE AND/OR EXPLOSIVE CHIPS GENERATED DURING PROCESSING.		POTENTIAL AGENT RELEASE TO ATMOSPHERE AND/OR PERSONNEL EXPOSURE.	FAILURE DETERRENCE NO SOURCE OF IGNITION HAS BEEN IDENTIFIED FROM THE CONVEYOR. THEREFORE, THIS FAILURE MODE REPRESENTS AT LEAST A SECOND ORDER OCCURRENCE. A MAINTENANCE PROGRAM WILL REMOVE THE MATERIAL.	3	1	3



BB NO. 6. ROCKET DEMIL MACHINE (RDM)

FMEA INFORMATION SOURCES

BB No. 6 — Rocket Demil Machine

DRAWINGS/DOCUMENTS:

06-526-1 16 Jul 74
-2 6 Aug
-3 15 Aug 72
-4 10 Aug 72
-5 10 Sep 74
-6 10 Apr 75

06-527-1 10 May 75
-2 3 Jun 75
-3 7 Jun 75

T-172-906 3/3 25 May 74

PERSONNEL REFERENCED:

Lt. Seeglitz
D. Barracough

CRITERIA NOTES:

- Visual inspection of nonoperative machine.
- Sequence by Lt. Seeglitz 7/31/75.
- Startup with active munitions is preceded by test runs, using inert munitions. The test runs will verify proper setting of all mechanical adjustments and functioning of all elements of ths system. Validation of setup and proper decon solutions will be part of this test activity.
- Changing of the decon solution will be done on a routine basis to prevent buildup of agent.

OTHER:

- Memorandum for Record, 19 May 1971, (R.C.C) SMUEA-WCP-E, Hydrogen Generation in the Test Cubicle
- Marquart Reports S1304, Engineering "Evaluation of the CAMDS Munitions Demil Machinery," Phase 1-Evaluation, Volume 1, August 1974.

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [X]
COMPONENT LEVEL [X]

BUILDING BLOCK: NO. 8. UTILITIES (UTL)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL		FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
8.1	BOILERS	SERVICES PROCESSES REQUIRING HEAT IN THE ADS DRYERS, METAL PARTS FURNACE, CENTRAL DECONTAMINATION SYSTEM AND EXPLOSIVE TREATMENT SYSTEM.	MODE - LOSS OF HOT WATER/STEAM. CAUSE(S) A. BOILER FAILURE.	EQUIPMENT THE CAMDS FACILITY MUST BE SHUT DOWN.	PERSONNEL	FAILURE DETERRENCE THE BOILERS ARE OVERDESIGNED (LARGE DESIGN MARGINS). PERIODIC MAINTENANCE WILL BE ACCOMPLISHED TWICE A YEAR. ONE BOILER IS OPERATING WHILE THE OTHER IS IN MAINTENANCE/STANDBY. NORMAL OPERATION IS TO RUN WITH ONE BOILER "UP" AND THE OTHER ON "IDLE" AND IN AN AUTOMATIC MODE. LOSS OF OUTPUT FROM THE "UP" BOILER AUTOMATICALLY BRINGS THE "IDLE" BOILER ON LINE. NEITHER BOILER IS THE PREFERRED BOILER. BOILER SHUTS DOWN IF ITS WATER LEVEL FALLS BELOW A CERTAIN POINT.	1	2	2
8.2	AIR COMPRESSORS	PROVIDES AIR FOR LEVEL "A" PROTECTIVE SUITS. PROVIDES AIR DEMIL MACHINERY OPERATION.	MODE - LOSS OF AIR SUPPLY. CAUSE(S) A. COMPRESSOR FAILURE.	PRODUCTION SHUTDOWN OF DEMIL MACHINERY.	AIR SUPPLY TO PROTECTIVE SUITS IS LOST.	FAILURE DETERRENCE SOME AIR RESERVE IS RESIDUAL IN THE SUITS. A SEPARATE AIR SUPPLY FOR THE SUITS I IS BEING CONSIDERED. THERE ARE TWO COMPRESSORS (EACH 220 SCFM CAPACITY, OUTPUT 100 PSIG AIR). BOTH COMPRESSORS ARE OPERATING (ONE "UP" PUTTING OUT 100 PSIG AIR, THE OTHER ON "IDLE"). IN THE EVENT OF A PRESSURE DROP THE "IDLE" COMPRESSOR COMES ON LINE. COMPRESSOR STATUS IS MONITORED AT THE CONTROL CENTER. TWO RECEIVERS ON THE COMPRESSORS (300 GALLONS) PROVIDE A TEMPORARY SOURCE OF AIR IN THE EVENT OF FAILURE TO BOTH COMPRESSORS, ALLOWING CORRECTIVE ACTION TO BE TAKEN. TWO ADDITIONAL INDEPENDENT TANKS SUPPLYING APPROXIMATELY 15 MINUTES OF RESERVE AIR ALSO MAY BE PROVIDED.	1	2	2

FMEA INFORMATION SOURCES

BB NO. 8 UTILITIES (UTL)

DRAWINGS/DOCUMENTS:

08-525-1	Feb 2'73
08-525-2	Feb 1'73
08-525-3	Nov 6'74
08-525-4	Aug 28'74

Draft Demil Plan for CAMDS at Tooele Army Depot

PERSONNEL REFERENCED:

R. Schorenberg
W. Darling

CRITERIA NOTES:

Design not reviewed for adequacy in size or conformity to Building Codes.

No review of Heating, Air Conditioning, and Water Supply.

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [X]

COMPONENT LEVEL [X]

BUILDING BLOCK: NO. 9. ECC HYDRAULICS (EHM)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
9.0	ECC HYDRAULICS (EHM) REFERENCE TCDS 08-308-02, 5-7-75 (PRELIMINARY UNAPPROVED DRAWING) ECC HYDRAULICS INCLUDE THE FOLLOWING COMPONENTS:	THE ECC HYDRAULICS SUPPLIES THE HYDRAULIC REQUIREMENTS FOR THE ECC, THE EQUIPMENT INSTALLED IN THE ECC, AND THE ECC INPUT AND DISCHARGE CONVEYORS.		EQUIPMENT				
9.1	RESERVOIR ASSEMBLY (INCLUDING: BAFFLE, PIPING, PUMP TO MOTOR COUPLING, CLEAN-OUT PLATES, OIL LEVEL GAGE, FILTER CAP, AND BREATHER ASSEMBLY)	CONTAINS ECC HYDRAULICS SUPPLY	MODE - LOSS OF HYDRAULIC FLUID. CAUSE(S) A. EXTERNAL LEAKAGE.	EXCESSIVE LEAKAGE WOULD CONSTITUTE A SAFETY HAZARD. AN INADEQUATE HYDRAULIC SUPPLY TO THE PUMP WOULD RESULT IN AN UNDER-PRESSURE CONDITION IN THE LINES, AT THE CONTROL VALVES, AND AT THE OPERATING UNITS WHICH WOULD NOT ALLOW ANY MUNITIONS DEMILITARIZATION LINES REQUIRING THE ECC, AND/OR EQUIPMENT INSTALLED IN THE ECC (RDN, PDM, MOR, OR MIN), AND/OR THE ECC INPUT AND DISCHARGE CONVEYORS TO BE OPERATED.	FAILURE DETERRENCE THE RESERVOIR ASSEMBLY WILL BE INCLUDED IN THE PERIODIC MAINTENANCE PROGRAM. TWO OIL LEVEL FLOAT SWITCHES ARE INSTALLED IN THE RESERVOIR. THESE SWITCHES, WHICH ARE INCLUDED IN THE COMPUTER CONTROL PLAN, ARE USED TO DETECT LARGE SCALE HYDRAULIC LOSSES. A HYDRAULIC LOSS LOWERING THE RESERVOIR HYDRAULIC LEVEL SUFFICIENTLY TO ACTIVATE THE FIRST SWITCH WOULD RESULT IN AN INDICATION OF THIS LOSS TO THE COMPUTER CONTROL. CONTINUED LOSS SUFFICIENT TO ACTIVATE THE SECOND SWITCH WOULD RESULT IN THE AUTOMATIC SHUTDOWN OF THE PUMP UNIT AND THE ENTIRE DEMILITARIZATION LINE.	2	1	2

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 9. ECC HYDRAULICS (EHM)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
9.1	RESERVOIR ASSEMBLY (CONTINUED)		MODE - CONTAMINATED HYDRAULICS. CAUSE(S) A. COMPONENT WEAR/DETERIORATION, ETC.	EQUIPMENT EXCESSIVE CONTAMINATION (IF INTRODUCED INTO THE SYSTEM) COULD RESULT IN DOWNSTREAM VALVE INTERNAL LEAKAGE AND/OR OTHER OUT OF SPECIFICATION VALVE OPERATION AND/OR OUT OF SPECIFICATION OPERATION AT THE OPERATING UNITS WHICH COULD IN TURN REQUIRE THE SHUTDOWN OF ALL DEMILITARIZATION OPERATIONS ASSOCIATED WITH THE ECC.	FAILURE DETERRENCE THERE IS A FILTER LOCATED AT THE PUMP INTAKE LINE TO ASSURE THAT CONTAMINATED HYDRAULICS IN THE RESERVOIR ARE NOT PUMPED INTO THE SYSTEM. THERE IS A FILTER LOCATED IN THE HYDRAULIC RETURN LINE TO ASSURE THAT CONTAMINATION GENERATED IN THE SYSTEM IS NOT INTRODUCED INTO THE RESERVOIR SUPPLY.	2	1	2
9.2	FILTER (PUMP INTAKE)	FILTER HYDRAULIC FLUID BEFORE IT IS PUMPED THROUGH THE SYSTEM.	MODE - CONTAMINATED HYDRAULICS ARE PUMPED INTO THE SYSTEM. CAUSE(S) A. LOSS OF FILTER FUNCTION.	EXCESSIVE CONTAMINATION COULD RESULT IN DOWNSTREAM VALVE INTERNAL LEAKAGE AND/OR OTHER OUT OF SPECIFICATION VALVE OPERATION AT THE OPERATING UNITS WHICH COULD REQUIRE THE SHUTDOWN OF ALL DEMILITARIZATION OPERATIONS ASSOCIATED WITH THE ECC.	FAILURE DETERRENCE THE FILTER WILL BE INSPECTED AS PART OF THE PERIODIC MAINTENANCE PROGRAM.	2	1	2

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 9. ECC HYDRAULICS (EHM)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
9.3	FILTER (RESERVOIR RETURN LINE)	FILTER HYDRAULIC FLUID THAT HAS BEEN PUMPED THROUGH THE SYSTEM TO ASSURE THAT CONTAMINATION GENERATED IN THE SYSTEM IS NOT INTRODUCED INTO THE RESERVOIR SUPPLY.	MODE - CONTAMINATED HYDRAULICS ARE INTRODUCED INTO THE RESERVOIR. CAUSE(S) A. LOSS OF FILTER FUNCTION.	EQUIPMENT THERE IS NO SIGNIFICANT CONSEQUENCE AS LONG AS THE CONTAMINATED HYDRAULICS ARE NOT RECIRCULATED THROUGH THE SYSTEM.	FAILURE DETERRENCE THERE IS A FILTER AT THE PUMP INTAKE TO ASSURE THAT CONTAMINATED HYDRAULICS FROM THE RESERVOIR ARE NOT INTRODUCED INTO THE SYSTEM. THE FILTERS WILL BE INSPECTED AS PART OF THE PERIOD MAINTENANCE PROGRAM.	1	1	1
9.4	SWITCH/FLOAT (UPPER RESERVOIR LEVEL)	THIS SWITCH/FLOAT MECHANISM IS USED TO DETECT LARGE SCALE HYDRAULIC FLUID LOSS. IN THE EVENT THAT THE HYDRAULIC FLUID FALLS TO A GIVEN LEVEL, THE FLOAT ACTUATES THE SWITCH (WHICH IS TIED INTO THE COMPUTER CONTROL SYSTEM) THEREBY INDICATING A LARGE FLUID LOSS.	MODE - PREMATURE SWITCH ACTUATION. CAUSE(S) A. A FAULTY SWITCH OR FLOAT.	FAILURE OF LITTLE CONSEQUENCE BUT WOULD REQUIRE INSPECTION AND CORRECTION.	FAILURE DETERRENCE THE SWITCH/FLOAT MECHANISM WILL BE INSPECTED AS PART OF THE PERIODIC MAINTENANCE PROGRAM.	1	1	1
			MODE - FAILURE OF SWITCH TO ACTUATE IN THE EVENT OF EXCESSIVE FLUID LOSS. CAUSE(S) A. A FAULTY SWITCH OR FLOAT. NOTE: THIS CONSTITUTES A DOUBLE FAILURE (EXCESSIVE LOSS OF FLUID AND SWITCH FAILURE).	NO EXCESSIVE FLUID LOSS SIGNAL AT THE COMPUTER. A CONTINUED FLUID LOSS AND SWITCH FAILURE WOULD RESULT IN THE LOSS OF FLUID BEING UNDETECTED UNTIL THE PUMP UNIT (AND THE DEMILITARIZATION LINE BEING SERVICED BY THE ECC HYDRAULICS) WAS AUTOMATICALLY SHUTDOWN BY THE COMPUTER CONTROL WHEN THE LOWER RESERVOIR LEVEL SWITCH/FLOAT ACTUATED.	FAILURE DETERRENCE PROPER OPERATION OF THE LOWER RESERVOIR LEVEL SWITCH/FLOAT WILL SHUT THE PUMP UNIT (AND ECC DEMILITARIZATION LINE) DOWN AND PREVENT POTENTIAL DAMAGE. *FAILURE OF SWITCH ONLY.	1	*2	2

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 9. ECC HYDRAULICS (EHM)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
9.5	SWITCH/FLOAT (LOWER RESERVOIR LEVEL)	THIS SWITCH/FLOAT MECHANISM IS USED TO DETECT LARGE SCALE HYDRAULIC FLUID LOSS. IN THE EVENT THAT THE HYDRAULIC FLUID FALLS TO A GIVEN LEVEL, THE FLOAT ACTUATES THE SWITCH (WHICH IS TIED INTO THE COMPUTER CONTROL SYSTEM) THEREBY CAUSING THE COMPUTER CONTROL TO SHUT DOWN THE PUMP UNIT (AND THE DEMILITARIZATION LINE BEING SERVICED BY THE ECC HYDRAULICS).	MODE - PREMATURE SWITCH ACTUATION. CAUSE(S) A. FAULTY SWITCH OR FLOAT.	EQUIPMENT AN ERRONEOUS EXCESSIVE FLUID LOSS SIGNAL AT THE COMPUTER. FAILURE WOULD CAUSE THE COMPUTER CONTROL TO AUTOMATICALLY SHUT DOWN THE PUMP UNIT (AND THE DEMILITARIZATION LINE BEING SERVICED BY THE ECC HYDRAULICS).	FAILURE DETERRENCE THE SWITCH/FLOAT MECHANISM WILL BE INSPECTED AS PART OF THE PERIODIC MAINTENANCE PROGRAM.	2	1	2
			MODE - FAILURE OF SWITCH TO ACTUATE IN THE EVENT OF EXCESSIVE FLUID LOSS. CAUSE(S) A. A FAULTY SWITCH OR FLOAT. NOTE: THIS CONSTITUTES A TRIPLE FAILURE (EXCESSIVE LOSS OF FLUID, FAILURE OF THE UPPER RESERVOIR LEVEL SWITCH/FLOAT TO ACTIVATE OR PERSONNEL IGNORING THE EXCESSIVE FLUID LOSS INDICATION, AND FAILURE OF THE LOWER RESERVOIR LEVEL SWITCH/FLOAT).	NO EXCESSIVE FLUID LOSS SIGNAL AT THE COMPUTER AND THEREFORE NO COMPUTER CONTROL COMMAND TO SHUT DOWN THE PUMP UNIT (AND THE DEMILITARIZATION LINE BEING SERVICED BY THE ECC HYDRAULICS). LOSS OF FLUID WOULD CONTINUE. EVENTUALLY AN INADEQUATE HYDRAULIC SUPPLY TO THE PUMP WOULD RESULT IN AN UNDERPRESSURE CONDITION IN THE LINES, AT THE CONTROL VALVES, AND AT THE OPERATING	FAILURE DETERRENCE PROPER OPERATION OF THE UPPER RESERVOIR LEVEL SWITCH/FLOAT WILL ALERT MAINTENANCE PERSONNEL TO THE EXCESSIVE LOSS OF FLUID. THE SWITCH/FLOAT MECHANISM WILL BE INSPECTED AS PART OF THE PERIODIC MAINTENANCE PROGRAM. *FAILURE OF LOWER RESERVOIR LEVEL SWITCH/FLOAT ONLY.	2	*2	4

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 9. ECC HYDRAULICS (EHM)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
9.5	SWITCH/FLOAT (LOWER RESERVOIR LEVEL) (CONTINUED)			EQUIPMENT UNITS WHICH WOULD NOT ALLOW ANY MUNITIONS DEMILITARIZATION LINES REQUIRING THE ECC, AND/OR EQUIPMENT INSTALLED IN THE ECC, AND/OR THE ECC INPUT AND DISCHARGE CONVEYORS TO BE OPERATED.				
9.6	ELECTRIC MOTOR AND HYDRAULIC PUMP	THE ELECTRIC MOTOR POWERS THE PUMP WHICH CIRCULATES HYDRAULIC FLUID AT 1000 PSI FROM THE RESERVOIR THROUGH THE ECC HYDRAULICS SYSTEM TO THE ECC, THE EQUIPMENT INSTALLED IN THE ECC, AND TO THE ECC INPUT AND DISCHARGE CONVEYORS.	MODE - ELECTRIC MOTOR OR PUMP FAILURE (ELECTRICAL, MECHANICAL) IN A MODE RENDERING THE UNIT INOPERATIVE AND RESULTING IN AN UNDERPRESSURE CONDITION IN THE HYDRAULIC LINES.	ALL MUNITIONS DEMILITARIZATION LINES REQUIRING THE ECC (AND/OR EQUIPMENT INSTALLED IN THE ECC - RDM, PDM, MOR, OR MIN) AND/OR THE ECC INPUT AND OUTPUT CONVEYORS MUST BE SHUT DOWN.	FAILURE DETERRENCE THE ELECTRIC MOTOR AND PUMP WILL BE INCLUDED IN THE PERIODIC MAINTENANCE PLAN. OPTIONS TO OPERATE MUNITIONS DEMILITARIZATION LINES NOT REQUIRING THE ECC AND/OR ITS ASSOCIATED EQUIPMENT (PROJECTILES/CARTRIDGES - GB/VX, WITHOUT BURSTERS, BULK ITEMS - GB/VX, TON CONTAINERS-MUSTARD) CAN BE CONSIDERED.	1	3	6
			MODE - ELECTRIC MOTOR OF PUMP FAILURE IN A MODE RESULTING IN A POTENTIAL OVERPRESSURE CONDITION IN THE UNIT AND LINES.	NOMINAL CASE - POTENTIAL OUT OF SPECIFICATION OPERATION OF CONTROL VALVES AND/OR DOWNSTREAM EQUIPMENT. WORST CASE - POTENTIAL RUPTURE OF UNIT OR HYDRAULIC LINES, RESULTING IN DEMILITARIZATION LINE SHUTDOWN AND A HAZARDOUS ENVIRONMENT.	FAILURE DETERRENCE EITHER FAILURE CONSEQUENCE WOULD REQUIRE A DOUBLE FAILURE (THE MOTOR/PUMP FAILURE PLUS A FAILURE IN THE HIGH PRESSURE RELIEF VALVE). THE ELECTRIC MOTOR AND PUMP WILL BE INCLUDED IN THE PERIODIC MAINTENANCE PLAN. *MOTOR/PUMP FAILURE ONLY.	2	*1	2

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 9. ECC HYDRAULICS (EHM)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
9.7	RELIEF VALVE	THE HIGH PRESSURE RELIEF VALVE PROVIDES PROTECTION FOR THE ECC HYDRAULIC SYSTEM IN THE EVENT OF AN OVERPRESSURE CONDITION.	MODE - LOSS OF SYSTEM HYDRAULIC FLUID AND PRESSURE. CAUSE(S) A. EXTERNAL LEAKAGE OR RELIEF VALVE OPERATION AT PRESSURES BELOW SPECIFICATION (1000 PSI).	EQUIPMENT THE RESULTING UNDER-PRESSURE CONDITION (MINIMUM OPERATING PRESSURE ALLOWABLE IS APPROXIMATELY 900 PSI) IN THE LINES, AT THE CONTROL VALVES, AND AT THE OPERATING UNITS WOULD NOT ALLOW ANY MUNITIONS DEMILITARIZATION LINES REQUIRING THE ECC, AND/OR EQUIPMENT INSTALLED IN THE ECC, AND/OR THE ECC INPUT AND DISCHARGE CONVEYORS TO BE OPERATED.	FAILURE DETERRENCE THE RELIEF VALVE WILL BE INCLUDED IN THE PERIODIC MAINTENANCE PROGRAM.	2	2	4
			MODE - FAILURE TO VENT (UNDER THE CONDITION OF EXCESSIVE LINE PRESSURE). CAUSE(S) A. THE RELIEF VALVE NOT OPERATING AT PRESSURES ABOVE SPECIFICATION (1000 PSI). NOTE: THIS CONSTITUTES A DOUBLE FAILURE (EXCESSIVE LINE PRESSURE AND RELIEF VALVE FAILURE).	WHEN THE RESULTING OVERPRESSURE CONDITION REACHES APPROXIMATELY 1500 PSI PUMP AND/OR VALVE OPERATIONAL PROBLEMS WOULD BEGIN TO OCCUR, NECESSITATING THE CESSATION OF DEMILITARIZATION OPERATIONS INVOLVING THE ECC AND ITS ASSOCIATED EQUIPMENT	FAILURE DETERRENCE THE RELIEF VALVE WILL BE INCLUDED IN THE PERIODIC MAINTENANCE PROGRAM. *RELIEF VALVE FAILURE ONLY.	3	*1	3

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 9. ECC HYDRAULICS (EHM)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
9.8	SENSOR, TEMPERATURE	PROVIDES DATA FOR REMOTE COMPUTER MONITORING OF THE SYSTEM.	MODE - FAULTY DATA OUTPUTS. CAUSE(S) A. SENSOR MALFUNCTION.	EQUIPMENT FAILURE OF LITTLE CONSEQUENCE, PROVIDED THE FAULTY DATA ARE CHECKED BEFORE ANY ACTIONS ARE TAKEN.	FAILURE DETERRENCE PERIODIC INSPECTION.	1	2	2
9.9	CHECK VALVE	PREVENTS OIL FROM BACK-FLOWING INTO THE PUMP AND ISOLATES (ALONG WITH THE RETURN LINE VALVES) THE ECC HYDRAULIC SYSTEM FROM THE ECC IN THE EVENT OF AN EXPLOSIVE INCIDENT IN THE ECC.	MODE - INTERRUMPTION OF HYDRAULIC SUPPLY TO THE ECC AND ITS ASSOCIATED EQUIPMENT. CAUSE(S) A. CHECK VALVE FAILING IN A CLOSED MODE.	DEMILITARIZATION OPERATIONS INVOLVING THE ECC AND ITS ASSOCIATED EQUIPMENT WOULD CEASE.	FAILURE DETERRENCE THIS FAILURE MODE SHOULD BE VERY REMOTE SINCE THE NORMAL SYSTEM OPERATING PRESSURE IS APPROXIMATELY 1000 PSI AND A DOWNSTREAM PRESSURE DIFFERENTIAL OF AS LITTLE AS APPROXIMATELY 5 PSI WOULD NORMALLY OPERATE THE CHECK VALVE.	2	1	2
			MODE - HYDRAULIC FLUID BACKFLOW INTO THE PUMP. CAUSE(S) A. CHECK VALVE FAILS OPEN.	FAILURE OF LITTLE CONSEQUENCE (NUISANCE TYPE FAILURE).	FAILURE DETERRENCE FAILURE WOULD BE FIXED DURING MAINTENANCE.	1	2	2
			MODE - HIGH UPSTREAM PRESSURE SURGE. CAUSE(S) A. OPEN OR LEAK FAILURE OF THE CHECK VALVE COINCIDING WITH AN EXPLOSIVE INCIDENT IN THE ECC. NOTE: THIS CONSTITUTES A DOUBLE FAILURE (EXPLOSIVE INCIDENT IN THE ECC AND A CHECK VALVE FAILURE).	THAT PORTION OF THE ECC HYDRAULICS (EHM) SYSTEM UPSTREAM OF THE CHECK VALVE WOULD NOT BE ISOLATED FROM THE EFFECTS OF AN EXPLOSION IN THE ECC.	CORRECTIVE ACTION THE CHECK VALVE SHOULD BE INSPECTED/TESTED PERIODICALLY. THE CHECK VALVE COULD BE FUNCTIONALLY TESTED BY CLOSING THE RETURN LINE NORMALLY CLOSED ISOLATION VALVES, VENTING (THROUGH THE RELIEF VALVE) THE PUMP OUTPUT LINE TO A PRESSURE LOWER THAN THE LINE DOWNSTREAM OF THE CHECK VALVE, AND THEN OBSERVING THE ACCUMULATOR PRESSURE GAUGE FOR A DROP IN PRESSURE WHICH WOULD INDICATE A CHECK VALVE LEAK. *CHECK VALVE FAILURE ONLY.	2	*2	4

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 9. ECC HYDRAULICS (EHM)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
9.10	HYDRAULIC ACCUMULATOR (BLADDER TYPE, NITROGEN-CHARGED)	THE ACCUMULATOR ASSURES A STEADY-STATE HYDRAULIC OUTPUT FROM THE ECC HYDRAULICS AT VARIOUS LOAD DEMAND.	MODE - LOSS OF HYDRAULIC FLUID. CAUSE(S) A. EXTERNAL LEAKAGE OR RUPTURE.	EQUIPMENT EXCESSIVE LEAKAGE WOULD CONSTITUTE A SAFETY HAZARD. IT WOULD ALSO RESULT IN AN UNDER-PRESSURE CONDITION IN THE LINES, AT THE CONTROL VALVES, AND AT THE OPERATING UNITS WHICH WOULD NOT ALLOW ANY MUNITIONS DEMILITARIZATION LINES REQUIRING THE ECC AND/OR ITS ASSOCIATION EQUIPMENT TO BE OPERATED.	FAILURE DETERRENCE THE ACCUMULATOR WILL BE INCLUDED IN THE PERIODIC MAINTENANCE PROGRAM. THE ACCUMULATOR WILL INCLUDE A PRESSURE GAUGE WHICH WILL INDICATE A LEAKAGE IN THE SYSTEM.	2	1	2
			MODE - HYDRAULIC FLUID CONTAMINATED WITH NITROGEN. CAUSE(S) A. PERMEATION OF, OR PHYSICAL FAILURE OF, THE BLADDER.	EXCESSIVE CONTAMINATION COULD EFFECT DOWNSTREAM VALVES AND/OR OPERATING UNITS (OUT OF SPECIFICATION CHARACTERISTICS).	CORRECTIVE ACTION THE BLADDER SHOULD BE INCLUDED IN THE PERIODIC MAINTENANCE/INSPECTION PROGRAM.	2	2	4

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 9. ECC HYDRAULICS (EHM)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
9.11	PRESSURE REDUCING VALVES (2)*	TWO* PRESSURE REDUCING VALVES ARE USED TO LOWER THE SYSTEM PRESSURE TO VALVES (AND OPERATING UNITS) IMMEDIATELY DOWNSTREAM. THE AMOUNT OF REDUCTION IS SET IN ACCORDANCE WITH THE REQUIREMENTS OF THE PARTICULAR MACHINE IN THE ECC.	MODE - DOWNSTREAM PRESSURE (TO THE SEQUENCE VALVES, CONTROL VALVES AND OPERATING UNITS) OUT OF SPECIFICATION. CAUSE(S) A. OUT OF SPECIFICATION (HIGH OR LOW) OPERATION OF THE PRESSURE REDUCING VALVES.	EQUIPMENT SUCCESSFUL OPERATION OF THE PARTICULAR MACHINE IN THE ECC DEPENDS ON "IN SPECIFICATION" OPERATION OF THE PRESSURE REDUCING VALVES. OUT OF SPECIFICATION OPERATION COULD RESULT IN FAILURE/SHUTDOWN OF THE DEMILITARIZATION LINE BEING RUN AT THAT TIME. THE FOLLOWING TABLE INDICATES WHICH DOWNSTREAM CONTROL VALVES AND OPERATING UNITS ARE AFFECTED BY REDUCING VALVE OPERATION.	FAILURE DETERRENCE THE PRESSURE REDUCING VALVES ARE ADJUSTABLE.	2	2	4

PRESSURE REDUCING VALVE	DOWNSTREAM SEQUENCE VALVE	DOWNSTREAM CONTROL VALVE	DOWNSTREAM OPERATING UNIT (ROCKET DEMIL MACHINE)	DOWNSTREAM OPERATING UNIT (PROJECTILE DEMIL MACHINE)	DOWNSTREAM OPERATING UNIT (MORTAR DEMIL MACHINE)	DOWNSTREAM OPERATING UNIT (MINE DEMIL MACHINE)	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
1	-	V1	SAW CLAMP NO. 5	BURSTER SAW JAW NO. 2	DATA NOT AVAILABLE	FWCR HYDRAULIC MOTOR	N/A	N/A	N/A
1	-	V3	SAW CLAMP NOS. 1, 2, 4, 6, AND STAKE	BURSTER SAW JAW NO. 1		CLAMPING CYLINDER			
1	1	V4	NOT USED FOR THIS MACHINE	BURSTER PULL		BOOSTER RETAINING RING PULLER			
1	1	V6	SWINGS	NOT USED FOR THIS MACHINE		RETAINING RING COLLET EXPANDER			
2	-	V2	SAW CLAMPS NOS. 3 AND 7	AP PUSH AND SWINGS		PUNCH CYLINDER			
2	-	V15	NOT USED FOR THIS MACHINE	NOT USED FOR THIS MACHINE		OUTPUT CONVEYOR (SEGREGATOR)			
2	-	V16	DISCHARGE & SEGREGATOR CONVEYOR	SEGREGATOR CONVEYOR		INPUT CONVEYOR			

*THIS QUANTITY IS BEING INCREASED TO FIVE (5) VALVES.

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 9. ECC HYDRAULICS (EHM)

	COMPONENT OR ITEM	FUNCTION		FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL		FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
9.11	PRESSURE REDUCING VALVES (2) (CONTINUED)									
	PRESSURE REDUCING VALVE	DOWNSTREAM SEQUENCE VALVE	DOWNSTREAM CONTROL VALVE	DOWNSTREAM OPERATING UNIT (ROCKET DEMIL MACHINE)	DOWNSTREAM OPERATING UNIT (PROJECTILE DEMIL MACHINE)	DOWNSTREAM OPERATING UNIT (MORTAR DEMIL MACHINE)	DOWNSTREAM OPERATING UNIT (MINE DEMIL MACHINE)			
	2	-	V17	ROCKET ECC INPUT CONVEYOR	OUTSIDE INPUT CONVEYOR	DATA NOT AVAILABLE	NOT USED FOR THIS MACHINE			
	2	2	V5	NOT USED FOR THIS MACHINE.	SWING AND SAW PUSH		90-DEGREE MINE TURNER			
9.12	SEQUENCE VALVES (2)	DOWNSTREAM OF EACH PRESSURE REDUCING VALVE THE HYDRAULIC LINE DIVIDES INTO TWO LINES. ONE OF THESE TWO LINES LEADS DIRECTLY TO SOME OF THE DOWNSTREAM CONTROL VALVES. THE OTHER LINE IS ROUTED THROUGH A SEQUENCE VALVE BEFORE GOING TO SOME OTHER DOWNSTREAM CONTROL VALVES. SETTING A SE SEQUENCE VALVE AT OTHER THAN FULL FLOW INHIBITS FLOW IN THAT LINE AND MAKES THE UNINHIBITED LINE THE PREFERRED FLOW PATH. THE SEQUENCE VALVES ARE NOT PLANNED TO BE USED AT THIS TIME (BUT MAY BE LATER) AND ARE THEREFORE SET AT FULL FLOW. FOR THESE REASONS THESE VALVES ARE NOT CONSIDERED FURTHER IN THIS ANALYSIS.			N/A	N/A		N/A	N/A	N/A	N/A

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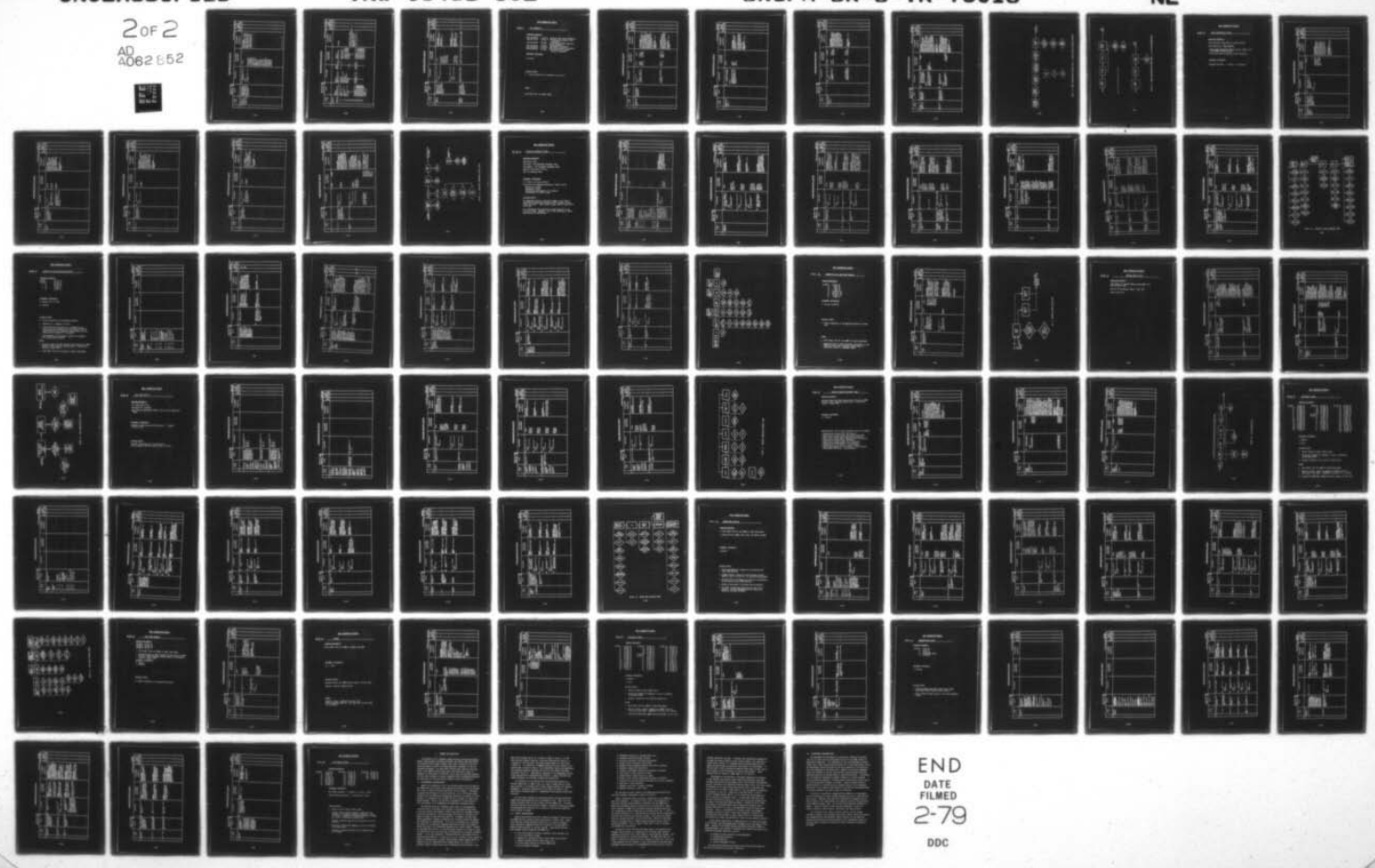

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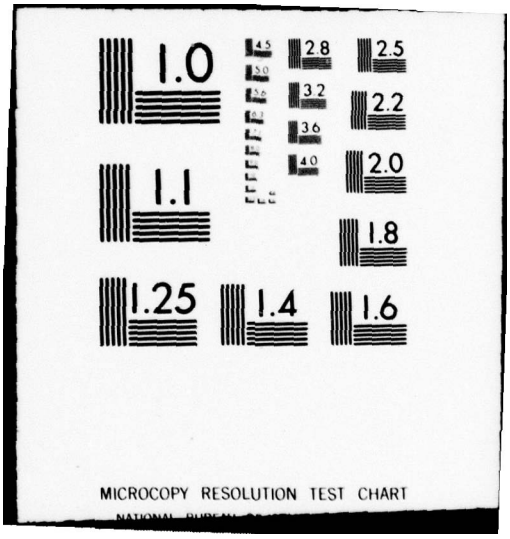
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FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 9. ECC HYDRALLICS (EHM)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
9.13	CONTROL VALVES (32 UNITS - 3 POSITION, 4 WAY, CLOSED CENTER 2 UNITS - 4 WAY, 3 POSITION, 3/4 INCH PORTS 35 GPM)	THESE VALVES CONTROL HYDRAULIC FLUID FLOW TO THE VARIOUS DOWNSTREAM OPERATING UNITS OF THE ECC, THE EQUIPMENT INSTALLED IN THE ECC (RDM, PDM, MDR, OR MIN), AND THE ECC INPUT AND DISCHARGE CONVEYORS.	MODE - DOWNSTREAM PRESSURE TO THE OPERATING UNIT NOT CONTROLLED TO SPECIFICATION. CAUSE(S) A. INTERNAL LEAKAGE OR VALVE FAILING CLOSED.	EQUIPMENT THE PROPER FUNCTION OF THE OPERATING UNIT WOULD BE LOST. THE CONSEQUENCE OF THE FAILURE DEPENDS ON THE CRITICALITY OF FUNCTION PERFORMED BY THE OPERATTING UNIT. THE FUNCTION OF EACH OPERATING UNIT DOWNSTREAM OF A GIVEN VALVE IS GIVEN IN THE FOLLOWING TABLE (DATA FOR VALVES 1,2,3,4,5,6,15, 16, AND 17 ARE GIVEN IN PARAGRAPH 9.11). THE FAILURE CONSEQUENCE AND CORRECTIVE ACTION FOR EACH OPERATING UNIT IS GIVEN IN THE FMEA ADDRESSING ITS PARTICULAR BUILDING BLOCK.	FAILURE DETERRENCE MOST OF THE OPERATING UNITS CONTAIN SWITCHES INDICATING THEIR PROPER FUNCTION. WHEN THE UNIT IS DETERMINED TO BE MALFUNCTIONING, AND THE TROUBLE IS TRACED TO THE VALVE, REPLACE/REPAIR WOULD BE REQUIRED. THE HYDRAULIC SYSTEM USES FILTERS TO PREVENT CONTAMINATION OF THE HYDRAULIC FUILD AND VALVE SEALS. *WITHIN THE BLOCK OF 34 UNITS.	2	*4	8

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 9. ECC HYDRAULICS (EHM)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL		FAILURE REFERENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
9.13	CONTROL VALVES (CONTINUED)						N/A	N/A	N/A
	CONTROL VALVE	DOWNSTREAM OPERATING UNIT (ROCKET DEMIL MACHINE)	DOWNSTREAM OPERATING UNIT (PROJECTILE DEMIL MACHINE)	DOWNSTREAM OPERATING UNIT (MORTAR DEMIL MACHINE)	DOWNSTREAM OPERATING UNIT (MINE DEMIL MACHINE)	ECC COMPONENTS			
	V1, V2, V3, V4, V5, V6, V15, V16, V17 (SEE PARAGRAPH 9.11.)								
	V7	NOT USED FOR THIS MACHINE	ΔP HEAD STROKE	DATA NOT AVAILABLE	BOOSTER PULLER ROD				
	V8	CARRIAGE	BURSTER LOCK		BOOSTER PULLER HEAD				
	V9	PROPELLANT STAKER	CARRIAGE VERTICAL, CARRIAGE HOLIZONTAL		PUNCH TURNER CYLINDER				
	V10	SAW NOS. 1, 3, 5, AND 6	PROJECTILE STOP AT ΔP		BOOSTER PULLER POSITIONER				
	V11	SAW NOS. 2 AND 4	ΔP HOLDING JAWS		FWCR POSITION CYLINDERS				
	V12	PUNCH CLAMP	PROJECTILE SAW JAW		NOT USED ON THIS MACHINE				
	V13	PUNCH	PROJECTILE TRAY ROLLERS		NOT USED ON THIS MACHINE				
	V14	NOT USED ON THIS MACHINE	BURSTER SAW		NOT USED ON THIS MACHINE				
	V18	ECC COMPONENT	ECC COMPONENT	ECC COMPONENT	ECC COMPONENT	VENT DOOR - SWING CYL, CLOSE CYL			
	V19					ITEM OUT DOOR - SWING CYL, CLOSE CYL			
	V20					ITEM IN, VENT, ITEM OUT, HIGH EXP OUT DRS-PIN CYL (4)			
	V21					HIGH EXP. OUT DR - SWING CYL, CLOSE CYL			
	V22					ITEM IN DR-SWING CYL, CLOSE CYL			
	V23					PERSONNEL DOOR - PIN CYL (3)			
	V24					PERSONNEL DOOR - SWING CYL (2)			
	V25	NOT USED FOR THIS MACHINE	CURRENT DATA NOT AVAILABLE	DATA NOT AVAILABLE	NOT USED ON THIS MACHINE				
	V26	ECC COMPONENT	ECC COMPONENT	ECC COMPONENT	ECC COMPONENT	EXTERIOR PERSONNEL DOOR LOCK CYL (4)			
	V27	NOT USED FOR THIS MACHINE	CURRENT DATA NOT AVAILABLE	DATA NOT AVAILABLE	NOT USED ON THIS MACHINE				
	V28	NOT USED FOR THIS MACHINE			NOT USED ON THIS MACHINE				
	V29	NOT USED FOR THIS MACHINE			NOT USED ON THIS MACHINE				
	V30	NOT USED FOR THIS MACHINE			NOT USED ON THIS MACHINE				
	V31	NOT USED FOR THIS MACHINE			NOT USED ON THIS MACHINE				
	V32	NOT USED FOR THIS MACHINE			NOT USED ON THIS MACHINE				
	V33	NOT USED FOR THIS MACHINE			NOT USED ON THIS MACHINE				
	V34	NOT USED FOR THIS MACHINE			NOT USED ON THIS MACHINE				
	V35	NOT USED FOR THIS MACHINE			NOT USED ON THIS MACHINE				
	-	ITEM ROLLERS (4), PSD ROLLER							
	-	POSITIONING SADDLE							

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 9. ECC HYDRAULICS (EHH)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
9.14	EXPLOSION PROTECTION VALVES (2)	THESE VALVES, WHICH ARE NORMALLY OPEN, CLOSE AUTOMATICALLY IN THE EVENT OF AN EXPLOSIVE INCIDENT IN THE ECC THEREBY PROTECTING THE ECC HYDRAULIC RESERVOIR FROM THE EFFECTS OF THE EXPLOSION.	MODE - THE VALVE/VALVES FAIL CLOSED. CAUSE(S) A. ELECTRICAL/MECHANICAL FAILURE.	EQUIPMENT THE ECC HYDRAULIC FLOW PATH WOULD BE BLOCKED, REQUIRING THE SHUTDOWN OF THE ECC, EQUIPMENT INSTALLED IN THE ECC, AND THE ECC INPUT AND DISCHARGE CONVEYORS.	FAILURE DETERRENCE THESE VALVES WILL BE INCLUDED IN THE PERIODIC MAINTENANCE PROGRAM. CORRECTIVE ACTION REPAIR/REPLACE THE VALVES.	1	1	1
			MODE - THE VALVE/VALVES FAIL OPEN. CAUSE(S) A. VALVE ELECTRICAL/MECHANICAL FAILURE.	POSSIBLE DAMAGE TO THE ECC HYDRAULIC SYSTEM IN THE EVENT OF EXPLOSIVE INCIDENT IN THE ECC.	FAILURE DETERRENCE THESE VALVES WILL BE INCLUDED IN THE PERIODIC MAINTENANCE PROGRAM. CORRECTIVE ACTION REPAIR THE DAMAGED ECC HYDRAULIC SYSTEM AND REPAIR/REPLACE THE VALVES.	2	2	4
9.15	PROJECTILE DISASSEMBLY FACILITY HYDRAULICS	THIS SYSTEM (SIMILAR TO THE ECC HYDRAULICS) SUPPLIES HYDRAULIC POWER FOR THE PROJECTILE PULL AND DRAIN EQUIPMENT AND THE BULK ITEM FACILITY.	SYSTEM SIMILAR TO THE ECC HYDRAULICS (REFERENCE PARAGRAPHS 9.1 THROUGH 9.14).	SYSTEM SIMILAR TO THE ECC HYDRAULICS (REFERENCE PARAGRAPHS 9.1 THROUGH 9.14).	SYSTEM SIMILAR TO THE ECC HYDRAULICS (REFERENCE PARAGRAPHS 9.1 THROUGH 9.14).	N/A	N/A	N/A

FMEA INFORMATION SOURCES

BB NO. 9 ECC HYDRAULICS

DRAWINGS/DOCUMENTS:

TCDS 08-308-02	1 May 75	Hydraulic Power Pack (Schematic)
TCDS 02-311-26	10 May 75	ECC Hydraulic Schematic (Door Mechanisms)
TCDS 06-306-04	No Date	Rocket Demil System, Hydraulic Piping Schematic
TCDS 06-306-50	No Date	RDM Hydraulic Schematic
TCDS 15-607-03	3 Feb 75	PDM System, Hydraulic Schematic
TCDS 25-607-02	No Date	M23 Mine Machine Systems Hydraulic Schematic

PERSONNEL REFERENCED:

Tim Thomas

CRITERIA NOTES:

o Visual inspection of incomplete unit on site

OTHER:

Draft Demil Plan for CAMDS (TEAD)

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [X]
COMPONENT LEVEL [ ]

BUILDING BLOCK: NO. 13. AGENT DESTRUCTION SYSTEM (ADS)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT	FAILURE CONSEQUENCE PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
13.1	VX DETOXIFICATION/ NEUTRALIZATION AREA	VX DETOXIFICATION BY ACID CHLORINATION FOLLOWED BY CAUSTIC NEUTRALIZATION.	MODE- VX/CHLORINE FIRE. CAUSE(S) A. Cl_2 ADDED TO REACTOR VESSEL CONTAINING VX , BUT WITH INSUFFICIENT OR NO HCl PRESENT.	DAMAGE TO EQUIPMENT SHUTDOWN AND MAINTENANCE.	POTENTIAL TOXIC RELEASE TO SCRUBBER AND CHARCOAL FILTER SYSTEM.	A. FAILURE DETERRENCE THE SIX STEP AUTOMATED SEQUENCE IS SUFFICIENTLY INTERLOCKED (I.E., TANK WEIGHTS, HCl ADDITION, SEQUENCE ENABLE, REACTOR SELECTION) TO PREVENT THE INADVERTENT CONTACT OF Cl_2 AND VX. THE SEQUENCE IS ALSO SUCH THAT Cl_2 CANNOT BE ADDED TO THE BATCH TANK UNTIL THE VX AND HCl ARE HOMOGENIZED. FINALLY SHOULD ALL PRIOR INTERLOCKS FAIL, A REACTOR HIGH TEMPERATURE OVERRIDE OF Cl_2 ADDITION IS PROVIDED. THE OCCURRENCE OF THIS MODE IS REGARDED AS EXTREMELY REMOTE. CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	3	1	3
			B. VX AND HCl INSUFFICIENTLY MIXED PRIOR TO Cl_2 ADDITION TO THE REACTOR VESSEL.	SHUTDOWN AND MAINTENANCE.	POTENTIAL TOXIC RELEASE TO SCRUBBER AND CHARCOAL FILTER SYSTEM.	B. FAILURE DETERRENCE AGITATOR OPERATION INTERLOCKED TO PRECLUDE INITIATION OF STEP 6 (Cl_2 ADDITION). REACTOR HIGH TEMPERATURE OVERRIDE OF Cl_2 ADDITION IS PROVIDED. THE OCCURRANCE OF THIS MODE IS REGARDED AS VERY REMOTE. CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	2	1	2

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [X]
COMPONENT LEVEL [X]

BUILDING BLOCK: NO. 13. AGENT DESTRUCTION SYSTEM (ADS)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
13.1	VX DETOXIFICATION/ NEUTRALIZATION AREA (CONTINUED)		MODE - HIGH TEMPERATURE OR RUNAWAY REACTION (ACID CHLORINATION). CAUSE(S) A. COOLING WATER SYSTEM FAILURE - PUMPS (2), VALVE, OR FLOW CONTROL REGULATOR AND FAILURE OF REACTOR HIGH TEMPERATURE OVERRIDE INTERLOCK AND OPERATOR FAILS TO TAKE ACTION.	EQUIPMENT POTENTIAL EQUIPMENT DAMAGE SHUTDOWN AND MAINTENANCE.	A. FAILURE DETERRENCE HIGH REACTOR TEMPERATURE INTERLOCK TO PREVENT FURTHER Cl_2 ADDITION. BOTH PUMPS WOULD HAVE TO FAIL (COOLING TOWER). SEVERAL ITEMS (INCLUDING INTERLOCK FAILURE AND OPERATOR INACTION) MUST OCCUR IN SERIES, THUS THE OCCURRENCE OF THIS MODE IS REGARDED AS EXTREMELY REMOTE. CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	2	1	2

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [X]
COMPONENT LEVEL [X]

BUILDING BLOCK: NO. 13. AGENT DESTRUCTION SYSTEM (ADS)

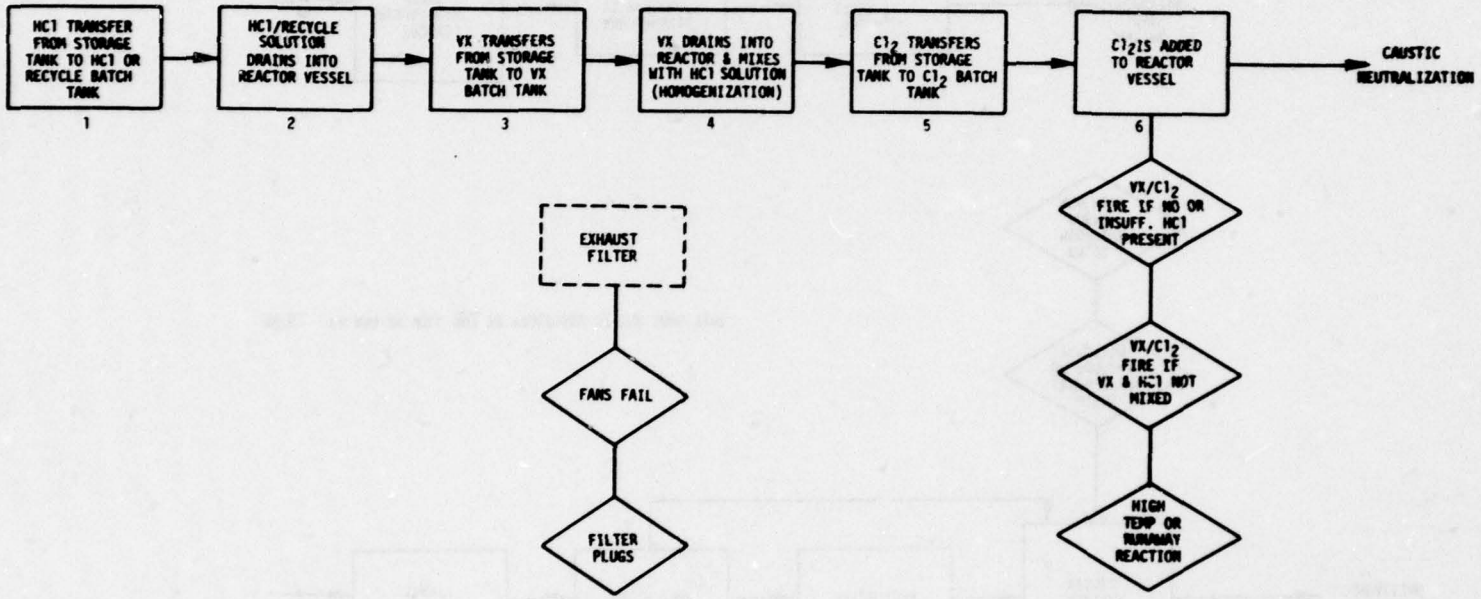
	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL		FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
				EQUIPMENT	PERSONNEL				
13.1	VX DETOXIFICATION/ NEUTRALIZATION AREA (CONTINUED)		MODE - FAILURE OF EXHAUST SYSTEM. CAUSE(S) A. BOTH EXHAUST FANS FAIL AND DIFFERENTIAL PRESSURE ALARM FAILS.	SHUTDOWN AND MAINTENANCE.	POTENTIAL DIFFUSION OF TOXIC VAPORS OUT OF TOXIC AREA.	FAILURE DETERRENCE DUAL EXHAUST BLOWERS (ONE FOR EACH DOUBLE CAPACITY FILTER BANK) ARE PROVIDED WITH ADEQUATE WARNING SHOULD ONE BLOWER FAIL. ALSO FOR THE CASE OF PRESSURE BUILDUP (FILTER PLUGGING) THE BUILDUP WOULD BE SLOW ALLOWING ADEQUATE TIME FOR REPLACEMENT. THE SERIES FAILURE OF BOTH BLOWERS, ALARMS, BACKUP SYSTEM PLUS FAILURE TO INITIATE AN EMERGENCY SHUTDOWN RENDERS THIS MODE AS BEING EXTREMELY REMOTE.	3	1	3
			B. EXCESSIVE PRESSURE BUILDUP IN FILTERS ALARMS FAILURE AND OPERATOR FAILS TO PERFORM ROUTINE MAINTENANCE.	SHUTDOWN AND MAINTENANCE.	POTENTIAL DIFFUSION OF TOXIC VAPORS OUT OF TOXIC AREA.	CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.			

FAILURE MODE AND EFFECT ANALYSIS

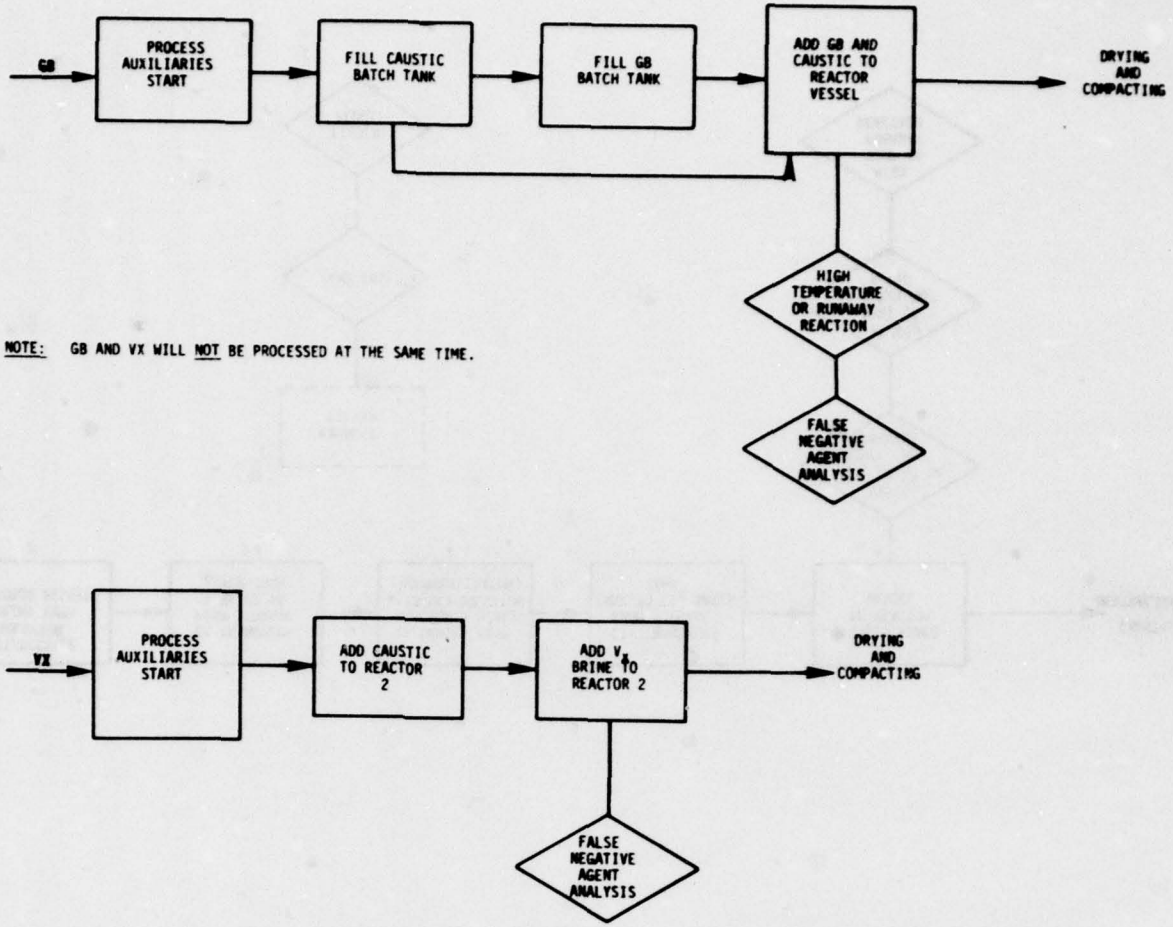
BUILDING BLOCK LEVEL [X]
COMPONENT LEVEL [ ]

BUILDING BLOCK: NO. 13. AGENT DESTRUCTION SYSTEM (ADS)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
13.2	GB AGENT DETOXIFICATION NEUTRALIZATION AREA	CAUSTIC (18% NaOH AQUEOUS SOLUTION) NEUTRALIZATION OF NERVE AGENT GB.	MODE - HIGH TEMPERATURE OR RUNAWAY REACTION AFTER GB AND CAUSTIC ARE SIMULTANEOUSLY ADDED TO DETOX REACTOR FROM INDIVIDUAL BATCH TANKS. CAUSE(S) A. FAILURE OF RECIRCULATION WATER FLOW OR PUMP, AND GB FEED VALVE OPERATION, AND FAILURE OF AUTOMATIC INTERLOCK SYSTEM.	EQUIPMENT / PERSONNEL SHUTDOWN AND MAINTENANCE POSSIBLE EQUIPMENT DAMAGE.	FAILURE DETERRENCE INTERLOCK FEATURE BETWEEN COOLING WATER JACKET TEMPERATURE, REACTOR TEMPERATURE AND THE CLOSING OF THE GB VALVE IN THE BATCH TANK. AUTOMATIC PROVISION FOR INCREASING H_2O FLOW TO JACKET. SHOULD ALL OTHER INTERLOCKS FAIL, THERE IS A REACTOR HIGH TEMPERATURE OVERRIDE OF AGENT BUILT INTO THE SYSTEM LOGIC. IN ADDITION, MANUAL CAPABILITY OF INCREASING WATER FLOW AND DECREASING GB FLOW IS PROVIDED. THE CONSIDERABLE NUMBER OF IN SERIES FAILURES THAT MUST OCCUR RENDER THIS MODE AS BEING EXTREMELY REMOTE. CORRECTIVE ACTION: NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	2	1	2
13.3	GB OR VX AGENT ANALYSIS	TO ANALYZE FOR PRESENCE OF AGENT AFTER VX ACID CHLORINATION, GB CAUSTIC NEUTRALIZATION, ETC.	MODE - AGENT ANALYSIS INDICATES NONE PRESENT WHEN IN FACT THERE IS. CAUSE(S) A. PROCESS FAILS TO COMPLETELY DETOXIFY BUT SUBSEQUENT ANALYSIS SHOWS NEGATIVE RESULTS.	POSSIBLE EXPOSURE OF TOXIC MATERIAL TO PERSONNEL.	FAILURE DETERRENCE LABORATORY TESTS HAVE INDICATED THAT SHOULD A BATCH OF AGENT COMPLETE THE REQUIRED CYCLE THE CHANCES OF HAVING LIVE AGENT PRESENT IS VERY REMOTE. IN ADDITION THE ANALYSIS OF THE SAMPLE "FAILS" IN A SAFE MANNER; I.E., THERE WILL BE FALSE POSITIVE BUT NOT FALSE NEGATIVE READINGS. CORRECTIVE ACTION: NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	3	1	3



BB NO. 13 AGENT DESTRUCTION SYSTEM (ADS) - (VX/GB CAUSTIC NEUTRALIZATION)



BB NO. 13 AGENT DESTRUCTION SYSTEM (ADS) - (VX ACID CHLORINATION)

FMEA INFORMATION SOURCES

BB NO. 13 **AGENT DESTRUCTION SYSTEM**

DRAWINGS/DOCUMENTS:

Microprocessor Logic Dwg. No. ECDS13-851-02

P&ID Drawing No. ECDS13-660-06

Sterns-Roger Conceptual Process Design of ADS I & II and Concept Design Changes

Preliminary Hazards Analysis of ADS (Hercules)

PERSONNEL REFERENCED:

Edgewood Personnel - J. Bartel, T. Gervasoni

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☒
COMPONENT LEVEL ☐

BUILDING BLOCK: NO. 14. EXPLOSIVE TREATMENT SYSTEM (ETS)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
14.1	ROUTINE MAINTENANCE OF MECHANICAL FILTERS AND CHARCOAL ABSORPTION COLUMNS	TO PERIODICALLY REMOVE AND REPLACE COLUMN FILTER MATERIALS (POLY BAGS AND CHARCOAL). THE SPENT MATERIALS ARE THEN SENT TO THE DEACTIVATION FURNACE/ SCRUBBER.	MODE - SPILLAGE OF SLUDGE SATURATED BAGS OR SPENT DECON SATURATED CHARCOAL DURING MANUAL TRANSPORT TO THE FURNACE AREA. CAUSE(S) A. OPERATOR ERROR.	PERSONNEL RELEASE OF EXPLOSIVE SLUDGE AND/OR SPENT DECON TO OUTSIDE AREA (DURING TRANSIT TO FURNACE, OTHERWISE SPILL IS TO SUMP AREA).	FAILURE DETERRENCE THE SLUDGE IS NOT EXPLOSIVELY SENSITIVE (AS DEMONSTRATED BY EXTENSIVE TESTING), HOWEVER, THE EXPLOSIVE SLUDGE SHOULD NOT BE ALLOWED TO DRY OUT. THE VACUUM METHOD OF SWEEPING CHARCOAL OUT OF COLUMNS MINIMIZES SPILLAGE. (VENT IS TO FACILITY AIR FILTER SYSTEM IN ANY CASE.) RELEASED MATERIAL HAS BEEN DETOXIFIED. PERSONNEL WEARING LEVEL B CLOTHING. CORRECTIVE ACTION IT IS RECOMMENDED THAT SPILLAGE GOING TO THE SUMP BE RECYCLED BACK THROUGH THE ETS.	2	2	4

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 14. EXPLOSIVE TREATMENT SYSTEM (ETS)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
14.2	MECHANICAL FILTER	FIRST LINE MECHANICAL FILTER OF SLUDGE FROM THE ECC (LARGE PARTICLES OF EXPLOSIVE, METAL, FIBER GLASS, ETC.).	MODE - FILTER PLUGS. CAUSE(S) A. EXCESSIVE SLUDGE BUILDUP. FAILURE TO PERFORM ROUTINE MAINTENANCE. B. AN ARTIFICIAL PLUGGING OCCURS DUE TO OPERATOR ERROR - I.E., DURING BAG REPLACEMENT THE OPERATOR FAILS TO SWITCH TO THE OTHER FILTER. (BOTH FILTER INLET VALVES CLOSED.).	EQUIPMENT SHUTDOWN AND MAINTENANCE. SHUTDOWN AND MAINTENANCE.	FAILURE DETERRENCE THE FILTER BAGS ARE REPLACED PERIODICALLY. HOWEVER, SHOULD AN EXCESSIVE PRESSURE DROP OCCUR AN INTERLOCK AND ALARM IS PROVIDED WITH THE ECC. IN ANY CASE, THE PRESSURE BUILDUP SHOULD BE SLOW (EXCEPT WHEN VALVES ARE INADVERTENTLY CLOSED) ALLOWING MANUAL OPERATION TO BE PERFORMED IN A TIMELY MANNER. CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	2	1	2

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 14. EXPLOSIVE TREATMENT SYSTEM (ETS)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
14.3	SURGE TANK	HANDLES FLOW OF SPENT DECON BETWEEN MECHANICAL FILTERS AND ACTIVATED CHARCOAL FILTERS.	MODE - SURGE TANK OVERFLOW. CAUSE(S) A. HIGH LEVEL SENSOR FAILURE.	EQUIPMENT SHUTDOWN AND MAINTENANCE.	FAILURE DETERRENCE HIGH LEVEL ALARM, LEVEL INDICATION INTERLOCKED WITH FILTER INLET VALVE AND SURGE TANK OUTLET VALVE. SHOULD MATERIAL BE RELEASED PERSONNEL WOULD TEST FOR TOXIC CONTAMINATION AND WEAR PROTECTIVE LEVEL B CLOTHING IF REQUIRED. SYSTEM IS DESIGNED SUCH THAT THE SPENT DECON IS RELATIVELY NON-TOXIC.(HOWEVER, THIS IS NOT ANALYTICALLY CONFIRMED - HENCE CAUTION OBSERVED WHEN HANDLING SPILLS.) CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	1	2	2

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL [X]

BUILDING BLOCK: NO. 14. EXPLOSIVE TREATMENT SYSTEM (ETS)

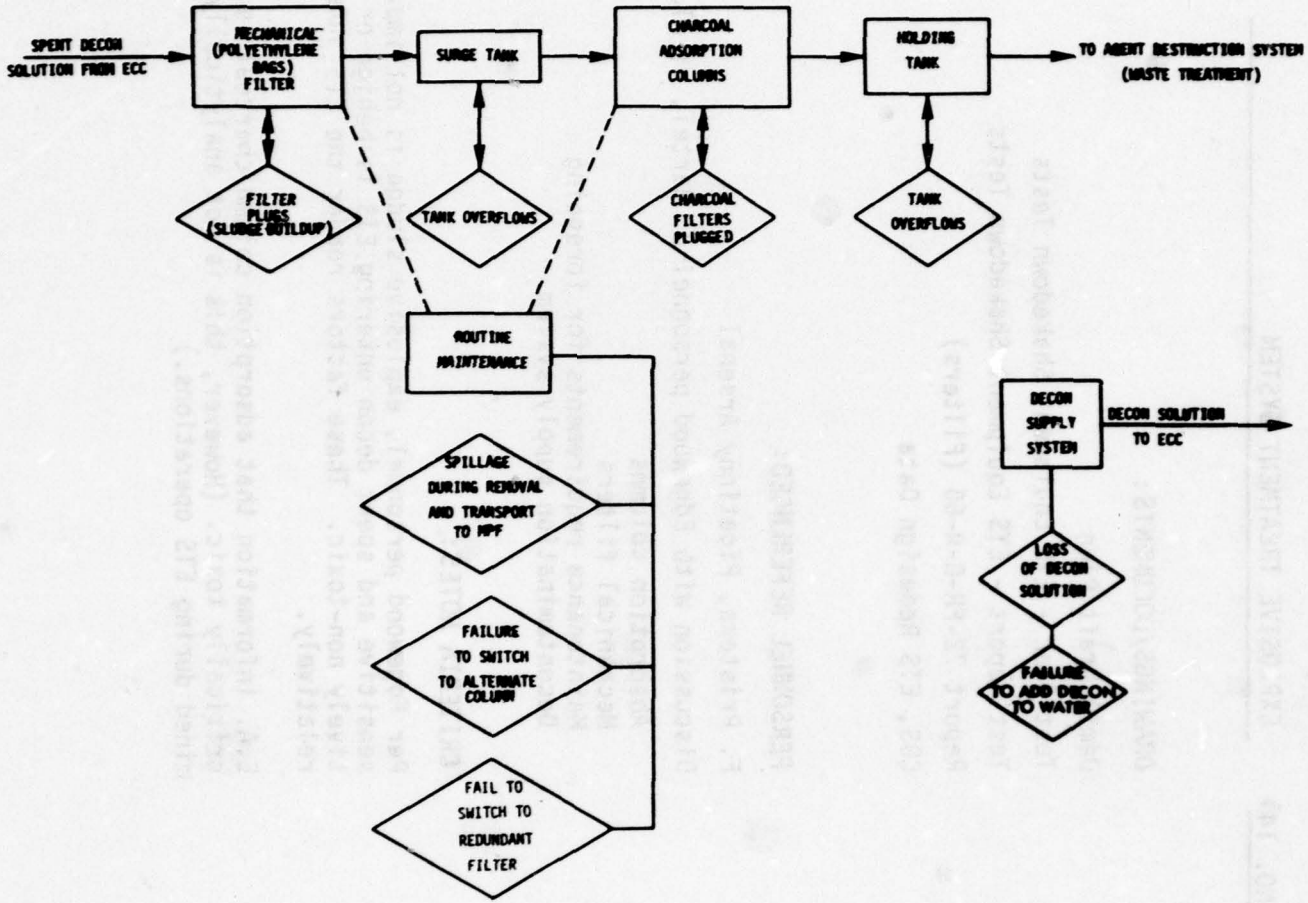
	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
14.4	ABSORPTION COLUMNS	ABSORBS DISSOLVED MATERIALS (EXPLOSIVES) TO PREVENT EXPLOSIVE DUST FROM BEING FORMED IN DRYER.	MODE - FILTER(S) SATURATED. CAUSE(S) A. EXCESSIVE BUILDUP. FAILURE TO MANUAL SWITCH TO THIRD COLUMN, SPENT DECON BYPASSES COLUMNS.	EQUIPMENT SHUTDOWN AND MAINTENANCE.	FAILURE DETERRENCE EXCESSIVE PRESSURE DROP ALARM TWO COLUMNS IN OPERATION (IN SERIES) THIRD ONE USED WHEN ROUTINE MAINTENANCE IS PERFORMED ON ONE COLUMN. THE COLUMNS ARE SWITCHED AND CHARCOAL REPLACED ON A PERIODIC BASIS. CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	1	2	2

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL [X]

BUILDING BLOCK: NO. 14. EXPLOSIVE TREATMENT SYSTEM (ETS)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL		FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
				EQUIPMENT	PERSONNEL				
14.5	HOLDING TANK	HOLD SPENT LIQUID THAT HAS PASSED THROUGH THE FILTER SYSTEM PRIOR TO BEING PUMPED TO THE AGENT DESTRUCTION SYSTEM UNTIL A SUFFICIENT AMOUNT IS PRESENT.	MODE - HOLD TANK OVERFLOW. CAUSE(S) A. HIGH LEVEL ALARM FAILS.	SHUTDOWN AND MAINTENANCE.		FAILURE DETERRENCE HIGH LEVEL SWITCH INTERLOCKED FOR AUTO SHUTDOWN OF THE INLET SUPPLY TO THE TANK. SHOULD OVERFLOW/ SPILLAGE OCCUR THE SPENT DECON IS RELATIVELY NON-TOXIC AND MAINTENANCE PERSONNEL ARE WEARING PROTECTIVE LEVEL B CLOTHING.(HOWEVER, THE NON-TOXICITY IS NOT ANALYTICALLY CONFIRMED; HENCE CAUTION IS MAINTAINED WHEN HANDLING SPILLS.)	1	2	2
14.6	DECON SUPPLY SYSTEM	PROVIDE DECON SOLUTION TO ECC.	MODE - LOSS OF DECON SOLUTION. CAUSE(S) A. DECON SUPPLY PUMP FAILURE.	SHUTDOWN AND MAINTENANCE.		FAILURE DETERRENCE FLOW IS TO ECC ON DEMAND. ECC DECON LEVEL IS MONITORED AND INTERLOCKED TO SAFE MODE SHUTDOWN. THE SUPPLY TANK IS TO BE EQUIPPED WITH A LOW LEVEL ALARM. NO RELEASE OF TOXIC MATERIAL IS ANTICIPATED. CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	2	1	2
			B. FAILURE TO FILL SUPPLY TANK.	POTENTIAL DAMAGE TO HEATER AND AGITATOR. SHUTDOWN AND MAINTENANCE.					
			C. FAILURE TO ADD DECON MATERIAL (SODIUM CARBONATE, DURING GB OPERATIONS) TO THE WATER - OPERATOR ERROR.		SPENT DECON WOULD BE MORE TOXIC AS RECEIVED BY THE ETS FROM THE ECC. HOWEVER, THIS DOES NOT PRESENT A RELEASE OF AGENT TO THE OUTSIDE AREA.	ROUTINE PROCEDURES WILL BE AVAILABLE. pH MEASUREMENT WITH ALARM WILL BE PROVIDED. THIS MODE DOES NOT APPEAR TO BE OF CRITICAL NATURE AS PLAIN WATER POSSESSES SOME DECON CAPABILITY.			



BB NO. 14. EXPLOSIVE TREATMENT SYSTEM (ETS)

FMEA INFORMATION SOURCES

BB. NO. 14 EXPLOSIVE TREATMENT SYSTEM

DRAWINGS/DOCUMENTS:

Demil Draft Plan

Test Plan - ETS Equipment Shakedown Tests

Test Report - ETS Equipment Shakedown Tests

Report 72-FR-G-R-66 (Filters)

CDS, ETS Redesign Data

PERSONNEL REFERENCED:

F. Pristera, Picatinny Arsenal

Discussion with Edgewood personnel-J. Bartel, et al.

Absorption columns
Mechanical filters
Maintenance requirements for foregoing
Decontamination supply system

CRITERIA NOTES:

Per Edgewood personnel, explosive sludge is not impact-sensitive and spent decon entering ETS is benign or relatively non-toxic. These factors render the ETS noncritical relatively.

E.A. information that adsorption column charcoal is not critically toxic. (However, this is not analytically determined during ETS operations.)

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [X]
COMPONENT LEVEL [X]

BUILDING BLOCK: NO. 15. PROJECTILE DEMIL MACHINE (PDM)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
15.0	PROJECTILE DEMILITARIZATION MACHINE (PDM)	REMOVES NOSE CLOSURES AND EXPLOSIVES FROM PROJECTILES AND CUTS THE EXPLOSIVE COMPONENTS INTO SEGMENTS FOR PROCESSING THROUGH THE DEACTIVATION FURNACE.		EQUIPMENT				
15.1	FUNCTIONALLY INTERFACING BUILDING BLOCKS							
	BB NO. 2 ECC	EXPLOSIVE/AGENT CONTAINMENT CUBICLE						
	BB NO. 9 EHM	HYDRAULIC PRESSURE SUPPLY						
	BB NO. 22 MHE	PSM INPUT CONVEYOR						
		PSM NOSE CLOSURE CONVEYOR						
		BSR BURSTER OUTPUT CONVEYOR						
		HE ECC DISCHARGE AND SEGREGATING CONVEYOR						
	BB NO. 30 CTV	REMOTE VISUAL MONITOR						
	BB NO. 31 COM	REMOTE AUDIO MONITOR						
	BB NO. 35 SCS	CONTROL SYSTEM						
15.2	PROJECTILE ECC INPUT CONVEYOR	RECEIVE MUNITION FROM UNPACK AREA PERSONNEL. EXTENDS INTO THE ECC AND MATES WITH AN INTERMEDIATE CONVEYOR OR THE DEMIL MACHINE. TRANSPORTS THE MUNITION TO THE NEXT HARDWARE ITEM, AND RETRACTS TO CLEAR THE ECC, ALLOWING ITEM IN DOOR CLOSURE.	MODE - MUNITIONS LOADED BACKWARDS BY UNPACK AREA PERSONNEL. CAUSE(S) A. HUMAN ERROR.	MUNITIONS LINE INTERRUPTION WHILE ERROR IS CORRECTED.	FAILURE DETERRENCE THE USE OF CONVEYOR MOUNTED TEMPLATES TO ASSURE PROPER ORIENTATION DURING THE LOADING OPERATION IS BEING CONSIDERED AND A TILT TABLE FOR 155 MM AND 8-INCH PROJECTILES IS BEING USED TO ASSURE PROJECTILE ORIENTATION.	1	4	4

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 15. PROJECTILE DEMIL MACHINE (PDM)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
15.2	PROJECTILE ECC INPUT CONVEYOR (CONTINUED)		MODE - FAILURE OF THE CONVEYOR TO MOVE IN THE ECC AND MATE WITH THE INTERMEDIATE CONVEYOR OR DEMIL MACHINE. CAUSE(S) A. FAILURE OF THE CONVEYOR POSITIONING MECHANISM.	EQUIPMENT FAILURE TO MATE CORRECTLY WILL NOT ALLOW THE NEXT STEP IN THE PROCESS TO BEGIN.	FAILURE DETERRENCE LIMIT SWITCHES INDICATE PROPER ALIGNMENT AND MATING.	1	4	4
			MODE - FAILURE TO CONVEY MUNITION. CAUSE(S) A. ACTUATION MOTOR FAILURE.	MUNITIONS LINE INTERRUPTION WHILE FAILURE IS CORRECTED.	FAILURE DETERRENCE DOWNSTREAM CONVEYOR DETECTS ARRIVAL OF MUNITION WITH SENSORS INSURING DETECTION OF MAJOR FAILURE.	1	4	4
			MODE - FAILURE OF CONVEYOR TO RETRACT FROM THE ECC. CAUSE(S) A. FAILURE OF THE CONVEYOR POSITIONING MECHANISM.	FAILURE TO RETRACT CORRECTLY WILL NOT ALLOW THE NEXT STEP IN THE PROCESS TO BEGIN.	FAILURE DETERRENCE LIMIT SWITCHES INDICATE PROPER RETRACTION.	1	4	4
			MODE - POSSIBLE CONTAMINATION OF THE CONVEYOR AT THE INTERMEDIATE CONVEYOR OR DEMIL MACHINE CONTACT POINT.	CONTAMINATED HARDWARE (CONVEYORS) ARE RETRACTED INTO THE UNPACK AREA (AIRLOCK).	FAILURE DETERRENCE THE AIRLOCK AREA IS MAINTAINED AT A NEGATIVE PRESSURE RELATIVE TO THE BALANCE OF THE UNPACK AREA. AGENT SENSORS ARE LOCATED IN THE UNPACK AREA. STANDARD OPERATING PROCEDURES FOR PERSONNEL MINIMIZE POTENTIAL FOR EXPOSURE.	2	4	8

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL [X]

BUILDING BLOCK: NO. 15. PROJECTILE DEMIL MACHINE (PDM)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
15.2	PROJECTILE ECC INPUT CONVEYOR (CONTINUED)	POWERED ROLLERS AND PUSH CYLINDER(S) MOVE MUNITIONS TO DEMIL STATIONS.	MODE - POWERED ROLLER FAILURE. CAUSE(S) A. ELECTRIC MOTOR FAILURE.	EQUIPMENT MUNITION LINE INTERRUPTION UNTIL FAILURE IS CORRECTED.	FAILURE DETERRENCE THE CONVEYOR OR MACHINE HAS A SENSOR TO DETECT PROPER TRANSFER OF THE MUNITION TO THE PDM. MOTOR FAILURE WOULD BE DETECTED BY THE ABSENCE OF THIS TRANSFER, HALTING THE DEMIL PROCEDURE.	1	4	4
			MODE - PUSH CYLINDER FAILURE. CAUSE(S) A. HYDRAULIC FAILURE.	MUNITION LINE INTERRUPTION UNTIL FAILURE IS CORRECTED.	FAILURE DETERRENCE LIMIT SWITCHES SENSE BOTH UP AND RETRACTED PUSH CYLINDER POSITIONS.	1	4	4
15.3	HYDRAULIC CLAMPS	HOLD PROJECTILE DURING SAWING.	MODE - FAILURE TO CLAMP AND/OR HOLD PROPERLY	ATTEMPT TO SAW ON AN UNRESTRICTED PROJECTILE COULD RESULT IN THE ITEM FALLING OFF THE MACHINE.	CORRECTIVE ACTION LIMIT SWITCHES ARE RECOMMENDED TO BE INCLUDED ON THE PDM TO INDICATE CLOSURE. FAILURE OF THE CONTROL SYSTEM TO RECEIVE THIS SIGNAL WOULD THEN RESULT IN SHUTDOWN OF THE PDM.	1	2	2
15.4	PROJECTILE SAW	CUTS THE FUSE OR NOSE CLOSURE PLUG OFF THE PROJECTILE.	MODE - FAILURE OF THE SAW TO SECTION OR COMPLETELY SECTION THE PROJECTILE. CAUSE(S) A. SAW BLADE FAILURE, MOTOR FAILURE, ETC.	THE BURSTER CANNOT BE REMOVED (AT THE NEXT STATION).	FAILURE DETERRENCE MONITORING OF THE SAW MOTOR CURRENT WOULD INDICATE IMPROPER SAW OPERATION. A LIMIT SWITCH INDICATES IF THE SAW HAS COMPLETED ITS TOTAL STROKE. THE SAW LOWERS AT A RATE OF 1/8-INCH PER SECOND. FAILURE OF THE CONTROL SYSTEM TO RECEIVE THIS SIGNAL WILL RESULT IN SHUTDOWN OF THE PDM; ANOTHER LIMIT SWITCH INDICATES WHEN THE SAW HAS RETRACTED.	1	2	2

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 15. PROJECTILE DEMIL MACHINE (PDM)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
15.5	CUTTING OIL/TANK AND PUMP FOR PROJECTILE SAW STATION	PROVIDES COOLING FLUIDS FOR THE SAW DURING CUTTING.	MODE - PUMP FAILURE (INOPERATIVE).	EQUIPMENT POSSIBLE EXPLOSIVE INCIDENT OR FIRE DUE TO EXCESSIVE HEAT GENERATED DURING SAWING WITHOUT COOLANT.	FAILURE DETERRENCE MONITORING OF SAW CURRENT WILL INDICATE EXCESSIVE LOAD REQUIREMENTS ON THE SAW. ALSO, A COOLANT FLOW MONITORING DEVICE WILL BE USED TO ASSESS COOLANT SYSTEM OPERATIONS.	3	2	6
			MODE - FILTER CLOGGING.	POSSIBLE EXPLOSIVE INCIDENT OR FIRE DUE TO EXCESSIVE HEAT GENERATED DURING SAWING WITHOUT COOLANT.	FAILURE DETERRENCE MONITORING OF SAW CURRENT WILL INDICATE EXCESSIVE LOAD REQUIREMENTS ON THE SAW. ALSO, A COOLANT FLOW MONITORING DEVICE WILL BE USED TO ASSESS COOLANT SYSTEM OPERATIONS. CHIPS WILL BE REMOVED AS A ROUTINE MAINTENANCE PROCEDURE.	3	2	6
15.6	LONG HYDRAULIC PUSH CYLINDER (PARTS OF THE PDM INPUT CONVEYOR)	THE CYLINDER PUSHES THE PROJECTILE AND NOSE CLOSURE OR FUSE FORWARD TO A CHUTE. THE NOSE CLOSURE DROPS DOWN THE CHUTE TO THE NOSE CLOSURE FUSE TRANSFER CONVEYOR AND THE PROJECTILE IS PUSHED TO A GATE.	MODE - FAILURE OF THE PUSH ROD TO MOVE THE PROJECTILE AND NOSE CLOSURE. CAUSE(S) A. ACTUATOR/HUDRAULIC SYSTEM FAILURE.	THE PROJECTILE WILL NOT BE THE CORRECT POSITION FOR BURSTER REMOVAL.	FAILURE DETERRENCE THE PROCESS IS MONITORED BY THE CLOSED CIRCUIT TV.	1	2	2
15.7	BURSTER REMOVAL STATION CLAMPS	CLAMPS AND HOLDS THE PROJECTILE FOR BURSTER REMOVAL.	MODE - FAILURE TO CLAMP AND HOLD PROPERLY.	IT WOULD BE IMPOSSIBLE TO PULL THE BURSTER.	CORRECTIVE ACTION LIMIT SWITCHES ARE RECOMMENDED TO BE INCLUDED ON THE PDM TO INDICATE CLOSURE. FAILURE OF THE CONTROL SYSTEM TO RECEIVE THIS SIGNAL WOULD THEN RESULT IN SHUTDOWN OF THE PDM.	1	2	2

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 15. PROJECTILE REMEL MACHINE

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
15.8	BURSTER PULLING DEVICE	REMOVES BURSTER FROM THE PROJECTILE.	MODE - FAILURE TO REMOVE THE BURSTER. CAUSE(S) A. LACK OF SUFFICIENT AIR PRESSURE TO ESTABLISH 40 TO 50 POUNDS P (SUPPLY PRESSURE LOW OR DEVICE SEAL FAILURE). B. HYDRAULIC ACTUATOR FAILS TO REMOVE BURSTER (HYDRAULIC SUPPLY FAILURE OR ACTUATOR FAILURE). C. BURSTER JAMMED.	EQUIPMENT FAILURE TO REMOVE THE BURSTER WILL PREVENT SUBSEQUENT REMOVAL OF THE AGENT AND FURTHER PROCESSING. IF THE BURSTER CANNOT BE REMOVED DUE TO A JAMMED BURSTER, TWO OPTIONS EXIST TO ALLEVIATE THE FAILURE: 1) PERSONNEL CAN ENTER THE ECC AND MANUALLY REMOVE THE PROJECTILE (PRACTICAL FOR ONLY SMALLEST MUNITIONS) AND RETURN IT TO THE UNPACK AREA. 2) ALLOW THE PROJECTILE TO PROCEED WITHOUT FURTHER PROCESSING AND REMOVE FROM THE CONVEYOR PRIOR TO THE PROJECTILE PULL AND DRAIN OPERATIONS.	FAILURE DETERRENCE INDICATOR SHOWS IF THE BURSTER HAS BEEN REMOVED. IF IT HAS NOT, THE CONTROL SYSTEM SHUTS DOWN FURTHER PROCESSING. THE PDM CAN BE REPROGRAMMED TO REPEAT THE BURSTER PULL ATTEMPT.	1	2	2
15.9	BURSTER SAW CLAMPS	CLAMPS AND HOLDS THE BURSTER FOR SECTIONING.	MODE - FAILURE TO CLAMP AND HOLD PROPERLY.	SAWING OPERATIONS COULD RESULT IN MECHANICAL DAMAGE TO THE EQUIPMENT (SAW BLADE BINDING OR BREAKAGE, ETC.).	CORRECTIVE ACTION LIMIT SWITCHES ARE RECOMMENDED TO BE INCLUDED ON THE PDM TO INDICATE CLOSURE. FAILURE OF THE CONTROL SYSTEM TO RECEIVE THIS SIGNAL WOULD THEN RESULT IN SHUT DOWN OF THIS PDM.	1	2	2

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL [X]

BUILDING BLOCK: NO. 15. PROJECTILE DEMIL MACHINE (PDM)

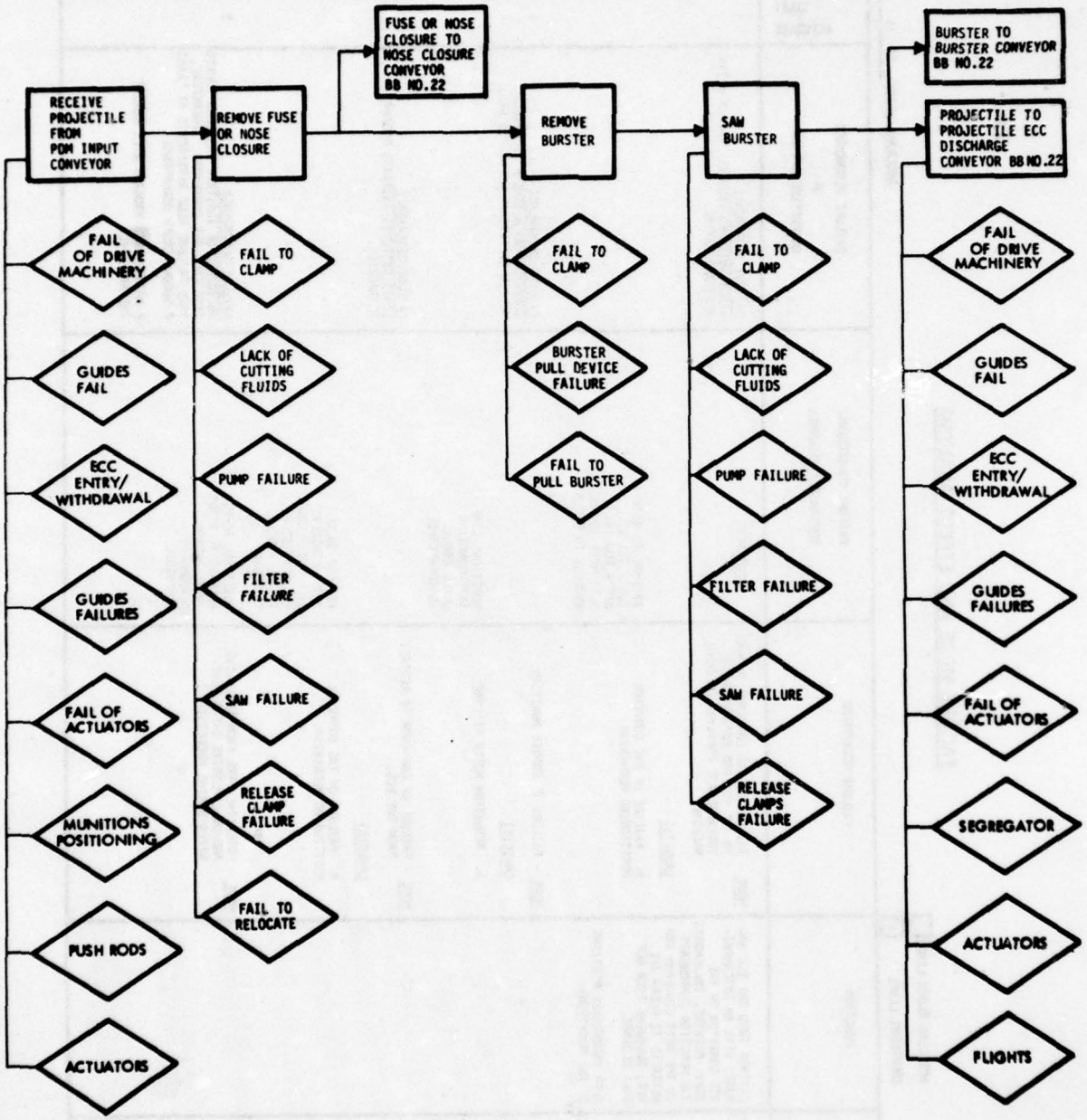
	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
15.10	BURSTER SAW	SAW THE BURSTER.	MODE - FAILURE OF THE SAW TO SECTION OR COMPLETELY SECTION THE BURSTER. CAUSE(S) A. SAW BLADE FAILURE, MOTOR FAILURE, ETC.	EQUIPMENT UNSAWED BURSTER COULD DAMAGE FURNACE. M71 AND M83 COULD DAMAGE THE FURNACE.	FAILURE DETERRENCE MONITORING OF THE SAW MOTOR CURRENT COULD INDICATE IMPROPER SAW OPERATIONS. VISUAL MONITORING VIA REMOTE TV WILL ALSO BE USED TO DETERMINE PROPER OPERATION.	2	2	4
15.11	CUTTING OIL/TANK AND PUMP FOR BURSTER SAW STATION	PROVIDES COOLING FLUIDS FOR THE SAW DURING CUTTING.	MODE - PUMP FAILURE (INOPERATIVE).	POSSIBLE EXPLOSIVE INCIDENT OR FIRE DUE TO EXCESSIVE HEAT GENERATED DURING SAWING WITHOUT COOLANT.	FAILURE DETERRENCE MONITORING OF SAW CURRENT COULD INDICATE EXCESSIVE LOAD REQUIREMENTS ON THE SAW. ALSO, A COOLANT FLOW MONITORING DEVICE WILL BE USED TO ASSESS COOLANT SYSTEM OPERATIONS.	3	2	6
			MODE - FILTER CLOGGING.	POSSIBLE EXPLOSIVE INCIDENT OR FIRE DUE TO EXCESSIVE HEAT GENERATED DURING SAWING WITHOUT COOLANT.	FAILURE DETERRENCE MONITORING OF SAW CURRENT COULD INDICATE EXCESSIVE LOAD REQUIREMENTS ON THE SAW. ALSO, A COOLANT FLOW MONITORING DEVICE WILL BE USED TO ASSESS COOLANT SYSTEM OPERATIONS. CHIPS WILL BE REMOVED AS A ROUTINE MAINTENANCE PROCEDURE.	3	2	6
15.12	BURSTER SAW CLAMPS AND PROJECTILE BURSTER REMOVAL CLAMPS	RELEASE BURSTER SECTIONS TO BURSTER OUTPUT CONVEYOR AND RELEASE PROJECTILE TO ECC DISCHARGE CONVEYOR.	MODE - FAILURE TO RELEASE. CAUSE(S) A. HYDRAULIC SYSTEM AND/OR ACTUATOR FAILURE	PROCESS CANNOT PROCEED TO THE NEXT STEP.	CORRECTIVE ACTION LIMIT SWITCHES ARE RECOMMENDED TO BE INSTALLED ON THE PDM TO INDICATE RELEASE. FAILURE OF THE CONTROL SYSTEM TO RECEIVE THIS SIGNAL COULD THEN RESULT IN SHUT DOWN OF THE PDM.	1	1	1

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 15. PROJECTILE DEMIL MACHINE (PDM)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
15.13	A) H.E. ECC DISCHARGE AND SEGREGATING CONVEYOR (PROJECTILE) B) PROJECTILE ECC DISCHARGE CONVEYOR	EXTENDS INTO THE ECC AND MATES WITH AN INTERMEDIATE CONVEYOR OR THE DEMIL MACHINE, TRANSPORTS THE MUNITION COMPONENTS TO THE NEXT CONVEYOR AND RETRACTS TO CLEAR THE ECC, ALLOWING ITEM OUT DOOR CLOSURE. ALSO SEGREGATES PORTIONS OF THE MUNITIONS.	MODE - FAILURE OF THE CONVEYOR TO MOVE IN THE ECC AND MATE WITH THE INTERMEDIATE CONVEYOR OR DEMIL MACHINE. CAUSE(S) A. FAILURE OF THE CONVEYOR POSITIONING MECHANISM.	EQUIPMENT FAILURE TO MATE CORRECTLY WILL NOT ALLOW THE NEXT STEP IN THE PROCESS TO BEGIN.	FAILURE DETERRENCE LIMIT SWITCHES INDICATE PROPER ALIGNMENT AND MATING.	1	4	4
			MODE - FAILURE TO CONVEY MUNITION. CAUSE(S) A. ACTUATION MOTOR FAILURE.	MUNITIONS LINE INTERRUMPTION WHILE ERROR IS CORRECTED.	FAILURE DETERRENCE CONVEYOR HAS A SENSOR TO DETECT MOTION (REFERENCE BB NO. 35 SCS).	1	4	4
			MODE - FAILURE OF CONVEYOR TO RETRACT FROM THE ECC. CAUSE(S) A. FAILURE OF THE CONVEYOR POSITIONING MECHANISM.	FAILURE TO RETRACT CORRECTLY WILL NOT ALLOW THE NEXT STEP IN THE PROCESS TO BEGIN.	FAILURE DETERRENCE LIMIT SWITCHES INDICATE PROPER RETRACTION.	1	4	4
			MODE - POTENTIAL FIRE FROM EXPLOSIVE AND/OR EXPLOSIVE CHIPS GENERATED DURING PROCESSING.	POTENTIAL AGENT RELEASE TO ATMOSPHERE AND/OR PERSONNEL EXPLOSURE.	FAILURE DETERRENCE NO SOURCE OF IGNITION HAS BEEN IDENTIFIED FROM THE CONVEYORS. THEREFORE, THIS FAILURE MODE REPRESENTS AT LEAST A SECOND ORDER OCCURRENCE. A MAINTENANCE PROGRAM WILL REMOVE THE MATERIAL.	3	1	3



BB NO. 15. PROJECTILE DEMIL MACHINE (PDM)

FMEA INFORMATION SOURCES

BB NO. 15 PROJECTILE DEMILITARIZATION MACHINE

DRAWINGS/DOCUMENTS:

15-533	30 Jul 73
15-533-1	29 Jan 73
" -2	29 Jan 73
" -3	29 Jan 73
" -4	7 Aug 73
" -5	9 Aug 73

PERSONNEL REFERENCED:

L. Johnson (31 Jul 1975)

D. Sorensen

CRITERIA NOTES:

- o Visual inspection of non-operating machine
- o Sequence by L. Thompson (7/31/75)
- o Startup with Active Munitions is preceded by test runs using inert munitions; the test runs will verify proper setting of all mechanical adjustments and functioning of all elements of the system.
- o Electromagnetic charge removal station not reviewed - will not be used at Tooele.

OTHER:

- o Marquardt Report #S-1304, Engineering Evaluation of CAMDS Munitions Demil Machinery Design, Phase 1, Evaluation, Volume 1, August 1974.
- o Draft Demil Plan for the Camds at Tooele, Army Depot

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [X]
COMPONENT LEVEL [ ]

BUILDING BLOCK: NO. 18. PROJECTILE PULL/DRAIN MACHINE (PPD)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
18.0	PROJECTILE PULL AND DRAIN MACHINE	REMOVE NOSE CLOSURE FROM NON-BURSTERED PROJECTILES. PULL BURSTER WELL. REMOVE VX AND GB AGENT.						
18.1	INTERFACING BUILDING BLOCKS							
	NO. 5 MPF	DECONTAMINATES METAL PARTS. DISPOSES OF MUSTARD AGENT.						
	NO. 13 ADS	DISPOSES OF VX AND GB AGENT.						
	NO. 19 CDS	SUPPLY DECON SOLUTION.						
	NO. 22 MHE	90-DEGREE TURN MACHINE PPF OUTPUT CONVEYOR METAL PARTS FURNACE OUTPUT CONVEYOR.						
	NO. 23 FIL	FILTERS EXHAUST AIR TO ATMOSPHERE.						
	NO. 26 PIP	REMOVE GB AND VX AGENT.						
	NO. 30 CTV	REMOTE VISUAL MONITOR.						
	NO. 31 COM	REMOTE AUDIO MONITOR.						
	NO. 35 SCS	CONTROL SYSTEM.						

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 18. PROJECTILE PULL/DRAIN MACHINE (PPD)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
18.2	LOAD CONVEYOR	RECEIVES THE PROJECTILE BASE END FIRST FROM THE 90-DEGREE TURN MACHINES MOTOR-DRIVEN RAM (B/B NO. 22, MHE). THE CONVEYOR HAS A SERIES OF CLAMPS MOUNTED ON IT. A CLAMP ATTACHES TO THE BASE OF THE PROJECTILE, SECURING IT TO THE CONVEYOR. AS THE CONVEYOR ADVANCES, THE PROJECTILE MOVES FROM A HORIZONTAL TO A VERTICAL POSITION.	MODE - PROJECTILE IS MOVED TO THE CONVEYOR NOSE END FIRST.	EQUIPMENT IT WOULD BE IMPOSSIBLE FOR THE CLAMP TO SECURE (DIMENSIONS INADEQUATE) TO THE NOSE OF THE PROJECTILE PROPERLY. DAMAGE (MECHANICAL) COULD OCCUR TO THE PPD HARDWARE FROM FALLING PROJECTILES PARTIALLY/INADEQUATELY CLAMPED.	FAILURE DETERRENCE PROJECTILES COMING FROM THE ECC (WHERE EXPLOSIVE MATERIAL WAS REMOVED) MUST BE PROPERLY ORIENTED (BASE FIRST) OR THEIR DISORIENTATION WOULD HAVE BEEN DETECTED EARLIER. PROJECTILES COMING DIRECTLY FROM THE UNPACK AREA CAN BE OBSERVED VIA REMOTE TV. REVERSE PROJECTILE-SENSOR SHOULD BE ADDED.	2 2	1 FROM ECC 2 FROM UPA	2 4
			MODE - CONVEYOR CLAMP FAILS TO PROPERLY SECURE THE PROJECTILE TO THE CONVEYOR THROUGH JAW WEAR, FAILURE TO RELEASE THE SPRING LOADED JAWS, OR PRE-RELEASE OF JAWS PRIOR TO LOADING.	EQUIPMENT MECHANICAL DAMAGE COULD OCCUR TO THE PPD HARDWARE FROM FALLING PROJECTILES PARTIALLY/INADEQUATELY CLAMPED.	FAILURE DETERRENCE CLAMP OPERATION WILL BE OBSERVED BY TV.	2	1	2

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL [X]

BUILDING BLOCK: NO. 18. PROJECTILE PULL/DRAIN MACHINE (PPD)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
18.3	NOSE CLOSURE REMOVAL STATION HARDWARE (CLAMPS, CARRIAGE, MOTOR, AND AIR PROBE)	CARRIAGE LOWERS CLAMPS TO THE NOSE CLOSURE. CLAMPS GRIP THE NOSE CLOSURE. MOTOR PROVIDES TORQUE TO UNTHREAD THE NOSE CLOSURE. CARRIAGE RAISES AND SHIFTS THE NOSE CLOSURE OVER A DROP POINT AND SIMULTANEOUSLY SHIFTS A PROBE OVER THE PROJECTILE. THE CLAMPS RELEASE THE NOSE CLOSURE AND THE CARRIAGE LOWERS THE PROBE INTO POSITION TO CHECK THE PROJECTILE FOR A BURSTER. (THIS STEP IS COMPLETED FOR ALL PROJECTILES WHETHER FROM THE ECC OR THE UNPACK AREA.) THE CARRIAGE RAISES THE PROBE, AND THE PROJECTILE IS READY TO PROCEED TO THE NEXT STATION.	MODE - FAILURE OF CARRIAGE TO LOWER, RAISE OR SHIFT. CAUSE(S) HYDRAULIC FAILURE OR MECHANICAL JAMMING. MODE - FAILURE TO CLAMP. CAUSE(S) WORN JAWS AND/OR PNEUMATIC FAILURE. MOTOR FAILURE PRECLUDING THE APPLICATION OF TORQUE TO THE NOSE CLOSURE.	EQUIPMENT THE NOSE CLOSURE WILL NOT BE REMOVED, AND OPERATIONS AT THE NEXT STATION CANNOT BE STARTED.	FAILURE DETERRENCE THE CLAMPS ARE 50-IN./LB CLAMPS AND EXERT APPROXIMATELY 3000 POUNDS CLAMPING FORCE. (APPROXIMATELY 200 IN/LB OF FORCE ARE REQUIRED TO REMOVE A NOSE CLOSURE.) A PROBE CHECKS THE PROJECTILE FOR THE PRESENCE OF A BURSTER AS THE NEXT STEP AFTER NOSE CLOSURE REMOVAL. IN THE EVENT THAT THE NOSE CLOSURE HAD NOT BEEN REMOVED THE PROBE WOULD SO INDICATE. LIMIT SWITCHES INDICATE WHEN THE CARRIAGE IS LOWERED AND SHIFTED.	1	2	2
			MODE - FAILURE OF PROBE, ALLOWING AN UNREMOVED NOSE CLOSURE OR THE PRESENCE OF A BURSTER TO GO UNDETECTED.	EQUIPMENT AT THE NEXT STATION (BURSTER WELL CUTTING STATION) ATTEMPT TO CUT AN UNREMOVED NOSE CLOSURE COULD DAMAGE THE CUTTING MECHANISM. ATTEMPT TO CUT AN UNREMOVED BURSTER WOULD POSSIBLY RESULT IN AN EXPLOSIVE INCIDENT.	FAILURE DETERRENCE THESE FAILURES REPRESENT DOUBLE FAILURES: (FAILURE TO REMOVE NOSE CLOSURE AND FAILURE OF THE PROBE TO DETECT NON-REMOVAL), (FAILURE OF BURSTER TO BE REMOVED IN THE ECC AND FAILURE OF PROBE TO DETECT NON-REMOVAL), (INADVERTENT LOADING OF A PROJECTILE CONTAINING A BURSTER ON THE UNPACK AREA BY-PASS CONVEYOR, ALLOWING THE PROJECTILE TO PROCEED DIRECTLY TO THE PPD AND FAILURE OF THE PROBE TO DETECT THE PRESENCE OF THE BURSTER). NOTE: ALL UNITS FROM THE UNPACK AREA (PROJECTILES STILL WITH NOSE CLOSURE WHEN THEY REACH THE PPD) ARE ASSUMED TO NOT INCLUDE BURSTERS.	3	1 (DOUBLE FAILURE)	3

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 18. PROJECTILE PULL/DRAIN MACHINE (PPD)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
18.4	BURSTER WELD CUTTING STATION HARDWARE (HYDRAULIC CLAMP, VERTICAL BORING MILL)	ONLY PROJECTILES THAT CONTAIN WELDED BURSTER WELLS ARE PROCESSED AT THIS STATION. (ONLY ABOUT 25,000 UNITS OF THIS TYPE WERE MADE) PLUS, THERE WERE AN UNDETERMINED NUMBER OF "LEAKERS" THAT WERE "FIXED" AFTER MANUFACTURE VIA MANUAL WELDING. THE HYDRAULIC CLAMP IS USED TO SECURE THE PROJECTILE DURING MILLING (IN ADDITION TO THE CONVEYOR MOUNTED CLAMP). THE MILL HEAD LOWERS, MILLS OFF THE WELD, AND RAISES. THE HYDRAULIC CLAMP RELEASES AND THE PROJECTILE PROCEEDS TO THE NEXT STATION.	MODE - FAILURE OF THE CALMP TO SECURE OR RELEASE THE PROJECTILE. CAUSE(S) WORN JAWS AND/OR HYDRAULIC FAILURE.	EQUIPMENT POSSIBLE MECHANICAL DAMAGE TO THE MILLING HEAD.	FAILURE DETERRENCE SWITCHES DETECT CLAMP POSITION.	1	1	1
			MODE - FAILURE OF THE MILLING MACHINE TO LOWER OR RAISE. CAUSE(S) LOSS OF HYDRAULIC PRESSURE.	EQUIPMENT THE WELD WILL NOT BE REMOVED, AND THE FUNCTION OF THE NEXT STATION CANNOT BE PERFORMED.	FAILURE DETERRENCE SWITCHES DETECT BOTH LOWERING AND RAISING.	1	1	1
			MODE - FAILURE OF THE MILLING PROCESS. CAUSE(S) MILL MOTOR OR MILL CUTTER FAILURE.	EQUIPMENT THE WELD WILL NOT BE REMOVED, AND THE FUNCTION OF THE NEXT STATION CANNOT BE PERFORMED.	FAILURE DETERRENCE THE CARBIDE "FLY CUTTERS" WILL BE REPLACED DAILY, IF NEEDED, THE MOTOR CURRENT WILL BE MONITORED. CORRECTIVE ACTION CONSIDERING MONITORING VIBRATION TO DETECT CUTTER FAILURES.	2	2	4

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 18. PROJECTILE PULL/DRAIN MACHINE (PPD)

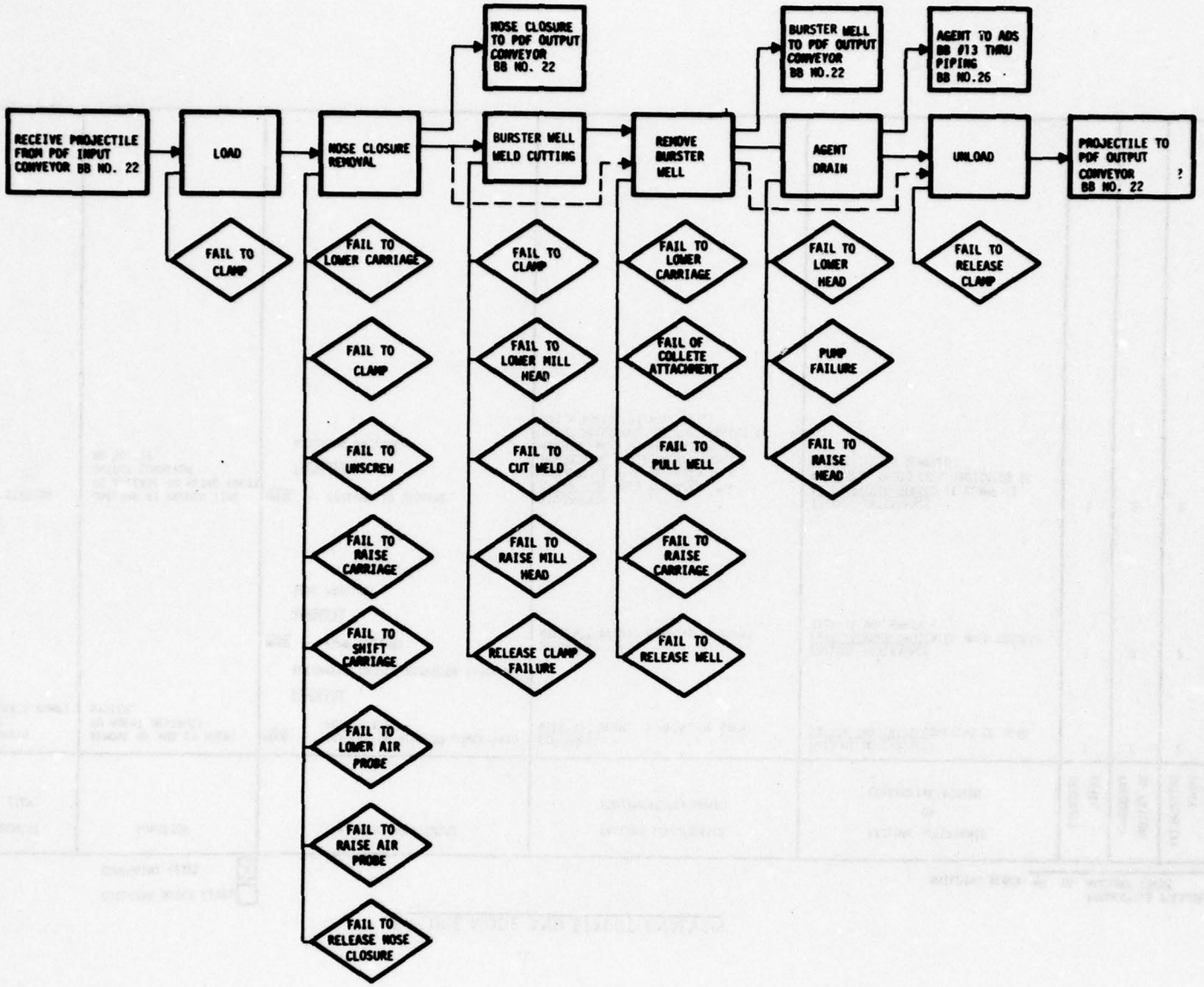
	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
18.5	BURSTER WELL PULL STATION HARDWARE (CARRIAGE AND COLLAR, COLLET, CHUTE, BELT CONVEYOR, AND DECON SOLUTION)	PULL THE BURSTER WELL FROM THE PROJECTILE AND RELEASE IT INTO THE CHUTE.	MODE - FAILURE OF THE CARRIAGE TO LOWER OR RAISE. CAUSE(S) HYDRAULIC FAILURE.	EQUIPMENT THE BURSTER WELL WILL NOT BE PULLED, OR IT WILL NOT BE POSSIBLE TO DISPOSE OF IT.	FAILURE DETERRENCE LIMIT SWITCHES INDICATE CARRIAGE POSITION (MAXIMUM UP AND MAXIMUM DOWN).	1	2	2
			MODE - FAILURE OF THE COLLAR TO ALIGN WITH THE PROJECTILE PROPERLY. CAUSE(S) PROJECTILE MISALIGNMENT OR MECHANICAL DAMAGE TO THE HARDWARE.	EQUIPMENT GOOD CONTACT SURFACES (COLLAR TO PROJECTILE) FOR PULLING WILL NOT BE OBTAINED, POSSIBLY RESULTING IN MECHANICAL DAMAGE TO THE EQUIPMENT.	FAILURE DETERRENCE GUIDE PINS ASSURE PROPER ALIGNMENT.	2	2	4
			MODE - FAILURE TO PULL THE BURSTER WELL. CAUSE(S) FAILURE OF THE COLLET TO GRIP OR OF THE ACTUATOR TO RETRACT.	EQUIPMENT THE PROCESSES AT THE NEXT STATION CANNOT BE ACCOMPLISHED.	FAILURE DETERRENCE A SWITCH INDICATES IF THE COLLET HAS BEEN LOWERED DOWN INSIDE THE PROJECTILE. ANOTHER SWITCH INDICATES IF THE COLLET HAS PULLED UP. TWO PHOTOELECTRIC CELLS ARE USED TO INDICATE THE PRESENCE OR ABSENCE OF A BURSTER WELL ATTACHED TO THE COLLET.	1	2	2
			MODE - FAILURE OF THE CHUTE TO OBTAIN PROPER POSITION BELOW THE BURSTER WELL. CAUSE(S) ACTUATOR FAILURE.	EQUIPMENT THE BURSTER WELL MAY NOT BE CONVEYED TO THE METAL PARTS FURNACE.	FAILURE DETERRENCE LIMIT SWITCHES INDICATE CHUTE POSITION	1	2	2
			MODE - FAILURE OF THE COLLET TO RELEASE BURSTER WELL. CAUSE(S) STICKING OR HYDRAULIC FAILURE.	EQUIPMENT THE BURSTER WELL MAY NOT BE CONVEYED TO THE METAL PARTS FURNACE.	FAILURE DETERRENCE TWO PHOTOELECTRIC CELLS ARE USED TO INDICATE THE PRESENCE OR ABSENCE OF A BURSTER WELL ATTACHED TO THE COLLET. THE BOTTOM OF THE BURSTER WELLS ARE ALWAYS AT THE SAME POSITION WHEN PULLED FROM THE PROJECTILE (EVEN THOUGH THE WELL LENGTH MAY VARY BETWEEN 12 3/4 AND 26 1/2 INCHES)	1	2	2

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [ ]
COMPONENT LEVEL [X]

BUILDING BLOCK: NO. 18. PROJECTILE PULL/DRAIN MACHINE (PPD)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
18.6	AGENT DRAIN STATION (HEAD, DRAIN PUMP)	REMOVE GB AND VX AGENT TO AGENT DESTRUCT SYSTEM.	MODE - FAILURE OF HEAD TO LOWER INTO PROJECTILE. CAUSE(S) ALIGNMENT AND/OR ACTUATOR FAILURE.	EQUIPMENT WILL NOT PERMIT PUMPING OF AGENT.	FAILURE DETERRENCE SWITCH INDICATES LOWERING OF HEAD.	1	2	2
			MODE - PUMP FAILURE. CAUSE(S) SEAL FAILURE.	EQUIPMENT WILL NOT PERMIT PUMPING OF AGENT.	FAILURE DETERRENCE LEVEL SENSOR INDICATES WHEN PROJECTILE IS 99% EMPTY.	1	2	2
18.7	UNLOAD STATION CLAMPS	UNCLAMP AT PROPER TIME TO RELEASE TO METAL PARTS OUTPUT CONVEYOR BB NO. 22.	MODE - FAILURE TO UNCLAMP. CAUSE(S) ACTUATOR FAILURE.	EQUIPMENT IF MACHINE BELT ADVANCES, THE PROJECTILE WILL BE MOVED TO A HORIZONTAL POSITION AND JAM THE MACHINE WHEN IT RETURNS TO THE START POSITION. IF THE PROJECTILE HAS H AGENT, IT WILL SPILL.	FAILURE DETERRENCE LIMIT SWITCH SENSES IF CLAMP IS RELEASED. PHOTO CELL INDICATES IF PROJECTILE IS REMOVED.	1	2	2


RECEIVE PROJECTILE FROM PDF INPUT CONVEYOR BB NO. 22
LOAD
FAIL TO CLAMP
NOSE CLOSURE REMOVAL
FAIL TO LOWER CARRIAGE
FAIL TO CLAMP
FAIL TO UNSCREW
FAIL TO RAISE CARRIAGE
FAIL TO SHIFT CARRIAGE
FAIL TO LOWER AIR PROBE
FAIL TO RAISE AIR PROBE
FAIL TO RELEASE NOSE CLOSURE
NOSE CLOSURE TO PDF OUTPUT CONVEYOR BB NO. 22
BURSTER WELL WELD CUTTING
FAIL TO CLAMP
FAIL TO LOWER MILL HEAD
FAIL TO CUT WELD
FAIL TO RAISE MILL HEAD
RELEASE CLAMP FAILURE
REMOVE BURSTER WELL
FAIL TO LOWER CARRIAGE
FAIL OF COLLETE ATTACHMENT
FAIL TO PULL WELL
FAIL TO RAISE CARRIAGE
FAIL TO RELEASE WELL
BURSTER WELL TO PDF OUTPUT CONVEYOR BB NO.22
AGENT DRAIN
FAIL TO LOWER HEAD
PUMP FAILURE
FAIL TO RAISE HEAD
AGENT TO ADS BB #13 THRU PIPING BB NO.26
UNLOAD
FAIL TO RELEASE CLAMP
PROJECTILE TO PDF OUTPUT CONVEYOR BB NO. 22

FMEA INFORMATION SOURCES

BB No. 18 PROJECTILE PULL AND DRAIN MACHINE

DRAWINGS/DOCUMENTS:

18-534-1	25 May 75
-2	2 May 75
-3	1 May 75
-4	1 May 75
-5	28 April 75
-6	29 April 75
-7	30 April 75
-8	6 May 75

PERSONNEL REFERENCED:

R. Stevens (7/30/75)

CRITERIA NOTES:

- o Visual Inspection of non-operating machine in model shop.

OTHER:

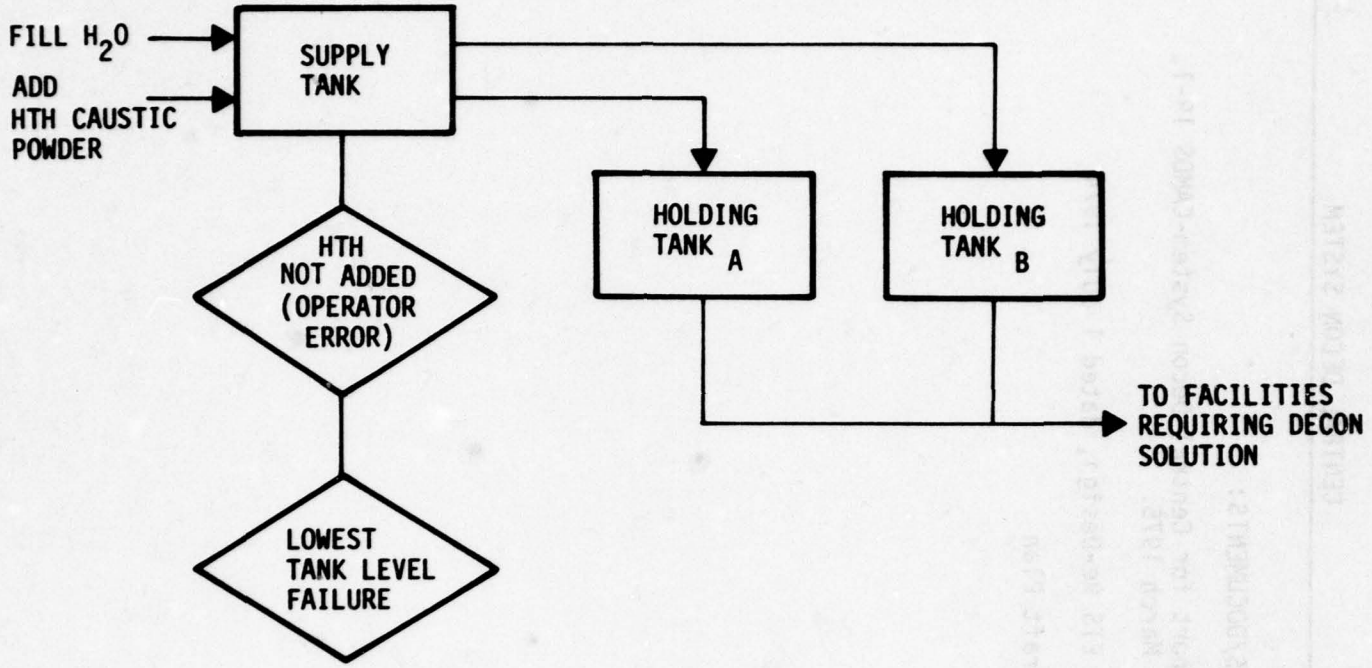
- O Draft Demil Plan for the CAMDS at Tooele Army Depot
- o Marquardt Report S-1314 Engineering Evaluation of the CAMDS Munitions Demil Machinery Design Phase 1, Evaluation Volume II, (December 1974).

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [ ]
COMPONENT LEVEL [X]

BUILDING BLOCK: NO. 19. CENTRAL DECON SYSTEM (CDC)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL		FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
				EQUIPMENT	PERSONNEL				
19.1	DECON MIXING TANK	MIX CALCIUM HYPOCHLORITE WITH WATER TO FORM DECON SOLUTION FOR VX/MUSTARD AGENT OPERATIONS.	MODE - LOSS OF DECON SOLUTION. CAUSE(S) A. OPERATOR FAILS TO TRANSFER HYPOCHLORITE POWDER OR VACUUM TRANSFER DEVICE FAILS. OPERATOR FAILS TO TAKE ACTION AND PLAIN WATER IS PIPED TO AREAS REQUIRING DECON SOLUTION.		POTENTIAL TOXIC EFFLUENT WHERE DECON SOLUTION IS NORMALLY USED. HOWEVER, THIS WOULD ULTIMATELY BE PROCESSED BY THE ADS OR ETS AND DOES NOT REPRESENT AN AGENT RELEASE TO THE OUTSIDE AREA.	FAILURE DETERRENCE pH MONITOR TO BE USED AS AN INDICATOR (BUT NOT FOR CONTROL). IN ADDITION, PERIODIC TITRATION FOR CHLORINE LEVEL WILL BE CARRIED OUT TO MONITOR STRENGTH OF SOLUTION. ALSO, THE SOLUTION IS YELLOWISH AND "MILKY" (DOES NOT LOOK LIKE PLAIN WATER). THIS MODE DOES NOT APPEAR TO BE OF A CRITICAL NATURE, SHOULD IT OCCUR. (EVEN PLAIN WATER HAS SOME DECON CAPABILITY.) HOWEVER, NO AUTOMATIC CONTROL OF POWDER FEED IS KNOWN.	2	2	4
			MODE - TANK LEVEL TOO LOW. CAUSE(S) A. LOW SET POINT FAILS REFILL AND LEVEL DROPS BELOW LOWEST SET POINT.	SHUTDOWN AND MAINTENANCE.		FAILURE DETERRENCE WHEN LOWEST SET POINT IS REACHED THE HEATER AND AGITATOR ARE AUTOMATICALLY SHUT OFF. IN ADDITION, AN ALARM SOUNDS IN THE CONTROL MODULE, THE POWER IS CUT OFF TO CDS PUMPS, AND THE CDS IS PLACED IN A MANUAL MODE. TEMPERATURE MONITORING WITH AUTOMATIC STEAM SHUT OFF IS ALSO PROVIDED. CORRECTIVE ACTION NONE RECOMMENDED.	1	2	2



NO. 19 CENTRAL DECON SYSTEM (CDC)

FMEA INFORMATION SOURCES

BB NO. 19 — CENTRAL DECON SYSTEM

DRAWINGS/DOCUMENTS:

Test Report for Central Decon System-CAMDS 19-1, dated 6 March 1975.

CDS and ETS Re-Design, dated 1 July 1974

Demil Draft Plan

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL [X]

BUILDING BLOCK: NO. 21. BULK ITEMS FACILITY (BIF)

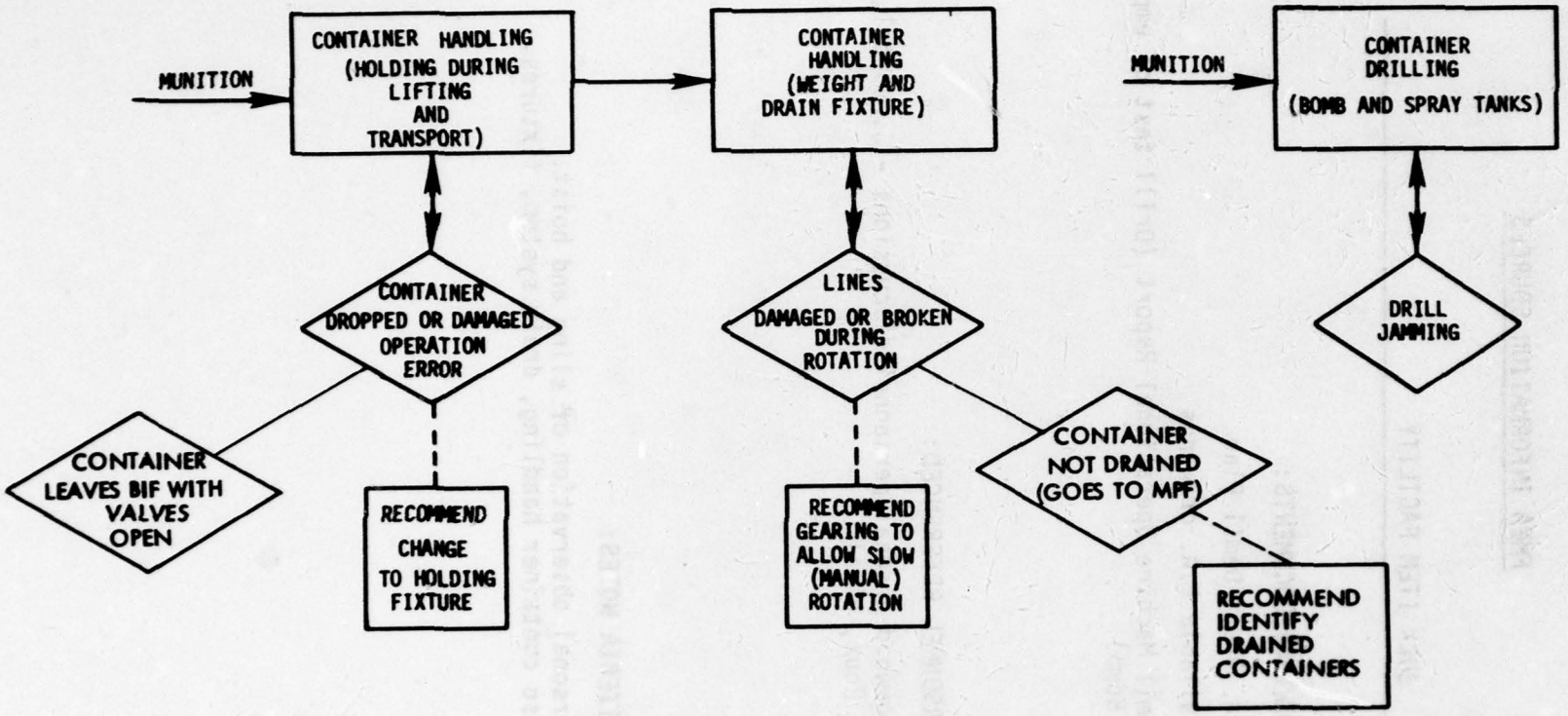
	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
21.1	CONTAINER HANDLING (LIFTING)	FORKLIFT WITH CONTAINER SLING TO MOVE CONTAINER FROM TRUCK TO BIF.	MODE - CONTAINER DAMAGED. CAUSE(S) A. FORKLIFT DAMAGES OR CONTAINER IS DROPPED DUE TO OPERATOR ERROR. (OPERATOR FAILS TO SECURE JAWS OF CONTAINER SLING TO CONTAINER.)	PERSONNEL POTENTIAL TOXIC RELEASE TO OUTSIDE AREA.	FAILURE DETERRENCE PERSONNEL WEARING PROTECTIVE CLOTHING. DECON SOLUTION AVAILABLE. A SAFETY PROCEDURE WILL BE PROVIDED. SAFETY HOOKS ARE PROVIDED ON TON CONTAINER HANDLING SLING (BUT NOT FOR BOMB OR SPRAY TANK). THE POSSIBILITY OF RUPTURE OF CONTAINER IS CONSIDERED REMOTE. *CORRECTIVE ACTION* • A MODIFICATION OF THE TON CONTAINER HANDLING SLING SUCH THAT THE JAWS ARE SPRING LOADED IN THE SECURE POSITION, IS RECOMMENDED. (CURRENTLY THE OPERATOR CAN POSITION THE JAWS MANUALLY TO ANY POSITION.) • SIMILAR CONSIDERATION, INCLUDING SAFETY HOOKS SHOULD BE GIVEN TO THE BOMB AND SPRAY TANK.	3	1	3
21.2	CONTAINER HANDLING (DRAIN FIXTURE)	TO DRAIN AGENT FROM CONTAINER	MODE - EPDM LINES TO TANK ARE BROKEN OR DAMAGED DURING DRAIN OPERATION. CAUSE(S) A. EXCESSIVE ROTATION OF CONTAINER BY OPERATOR - ROTATION TOO FAST AND OPERATOR DOES NOT RELEASE ROTATE BUTTON IN TIME.	POTENTIAL TOXIC RELEASE (TO TOXIC AREA).	FAILURE DETERRENCE A RELEASE WOULD BE TO A TOXIC AREA. FOR A SLIGHTLY DAMAGED LINE, A REPAIR MIGHT BE ACHIEVED THROUGH THE ACCESS WINDOW. IN ANY CASE, SHOULD PERSONNEL BE REQUIRED TO ENTER THE TOXIC AREA (AS THEY ARE FOR ROUTINE MAINTENANCE) THEY WOULD BE IN CLASS A CLOTHING.	2	1	2

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [X]
COMPONENT LEVEL [X]

BUILDING BLOCK: NO. 21. BULK ITEMS FACILITY (BIF)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL		FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
21.2	CONTAINER HANDLING (DRAIN FIXTURE) (CONTINUED)					CORRECTIVE ACTION ADDITION OF APPROPRIATE GEARING TO ALLOW SLOWER ROTATION OF THE CONTAINER, IS RECOMMENDED. WITH THE CURRENT DESIGN A RELATIVELY FAST ROTATION RATE SEEMS NECESSARY TO OVERCOME THE INERTIAL MASS OF THE CONTAINER. IN ADDITION, AN INTERLOCK ON ROTATION SHOULD BE PROVIDED, PRECLUDING INADVERTENT OPERATION			
			MODE - FILLED (GB/VX) CONTAINER PASSES THROUGH BIF AND IS PROCESSED IN THE METAL PARTS FURNACE. CAUSE(S) A. OPERATOR(S) ERROR - CONTAINER BYPASSES DRAIN AND RINSE AREA AND IS PICKED UP AS AN EMPTY CONTAINER.	SHUTDOWN AND MAINTENANCE WITH DAMAGE TO FURNACE IF CONTAINER EXPLODES.	POTENTIAL TOXIC (AGENT) RELEASE TO THE ATMOSPHERE (ENTIRE CONTENTS OF CONTAINER DELIVERED TO THE BURNER/ SCRUBBING SYSTEM CAUSING AN OVERLOAD CONDITION.)	FAILURE DETERRENCE RIGOROUS TRAINING AND OPERATIONAL PROCEDURES TO BE PROVIDED. FACILITY IS DESIGNED SUCH THAT CONTAINERS MUST PASS THROUGH THE DRAIN AND RINSE AREA TO GET TO THE HOLD AREA PRIOR TO DELIVERY TO THE MPF. AGENT MONITORING INSTRUMENTATION IS PROVIDED IN THE DECON RINSE AREA. CORRECTIVE ACTION IDENTIFY CONTAINERS THAT HAVE BEEN DRAINED. (E.G., AFTER VERIFYING DRAINED WEIGHT, SPRAY PAINT YELLOW BAND AROUND EDGE OF CONTAINER.)	4	1	4
21.3	DRILL MACHINE	TO DRILL HOLE IN BOMB OR SPRAY TANK FOR DRAINAGE PURPOSES.	MODE - DRILL JAMS. CAUSE(S) A. SPIRAL CHIPS MIGRATE UP FLUTES.	SHUTDOWN AND MAINTENANCE.		FAILURE DETERRENCE SHORT DRILL BITS TO BE USED- CHIPS TO BE CONTAINED IN SEALED PLENUM AT LOCATION OF THE PENETRATION. TESTS TO DATE HAVE INDICATED THAT THIS IS NOT A SERIOUS PROBLEM. CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	1	2	2



BB NO. 21. BULK ITEMS FACILITY (BIF)

FMEA INFORMATION SOURCES

BB NO. 21 BULK ITEM FACILITY

DRAWINGS/DOCUMENTS:

E.A. Draft Demil Plan

Available E.A. drawings

Demil Machine Operational Report (Drill test of empty MC-1 Bomb)

PERSONNEL REFERENCED:

Edgewood Arsenal personnel discussions - J. Bartel, R. Roux, et al.

CRITERIA NOTES:

Personal observation of sling and hoist.
Also container handling, drain system, fixtures.

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [X]
COMPONENT LEVEL [ ]

BUILDING BLOCK: NO. 22. MATERIAL HANDLING EQUIPMENT (MHE)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE REFERENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
22.1	A. ROCKET ECC INPUT CONVEYOR B. PROJECTILE ECC INPUT CONVEYOR C. MINE ECC INPUT CONVEYOR D. MORTAR ECC INPUT CONVEYOR (ITEMS A, B, AND D ARE SIMILAR IN DESIGN. ALL ITEMS ARE SIMILAR IN FUNCTION.)	RECEIVE MUNITION FROM UNPACK AREA PERSONNEL. EXTENDS INTO THE ECC AND MATES WITH AN INTERMEDIATE CONVEYOR OR THE DEMIL MACHINE. TRANSPORTS THE MUNITION TO THE NEXT HARDWARE ITEMS, AND RETRACTS TO CLEAR THE ECC, ALLOWING ITEM IN DOOR CLOSURE.	REFER TO THE FOLLOWING BUILDING BLOCKS FOR ANALYSIS: RDM - NO. 6 PDM - NO. 15 MIN - NO. 25 MOR - NO. 24					
22.2	A. RDM INPUT CONVEYOR B. PDM INPUT CONVEYOR (ITEM A AND B ARE SIMILAR IN DESIGN AND FUNCTION.)	POWERED ROLLERS AND PUSH CYLINDER(S) MOVE MUNITIONS TO DEMIL STATIONS.	REFER TO THE FOLLOWING BUILDING BLOCKS FOR ANALYSIS: RDM - NO. 6 PDM - NO. 15					
22.3	A. ROCKET ECC DISCHARGE AND SEGREGATING CONVEYOR B. H.E. ECC DISCHARGE AND SEGREGATING CONVEYOR (PROJECTILE) C. PROJECTILE ECC DISCHARGE CONVEYOR	EXTENDS INTO THE ECC AND MATES WITH AN INTERMEDIATE CONVEYOR OR THE DEMIL MACHINE, TRANSPORTS THE MUNITION COMPONENTS TO THE NEXT CONVEYOR AND RETRACTS TO CLEAR THE ECC, ALLOWING ITEM OUT DOOR CLOSURE. (ITEMS A,B,D, AND E ALSO SEGREGATE PORTIONS OF THE MUNITIONS.)	REFER TO THE FOLLOWING BUILDING BLOCKS FOR ANALYSIS: RDM - NO. 6 PDM - NO. 15 MIN - NO. 25 MOR - NO. 24					

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [X]
COMPONENT LEVEL [ ]

BUILDING BLOCK: NO. 22. MATERIAL HANDLING EQUIPMENT (MHE)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERMINANCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
22.3	(CONTINUED) D. MINE ECC DISCHARGE AND SEGREGATING CONVEYOR E. H.E. ECC DISCHARGE AND SEGREGATING CONVEYOR (MORTAR) F. MORTAR ECC DISCHARGE CONVEYOR (ITEMS B AND E, AND C AND F ARE SIMILAR IN DESIGN. ALL ITEMS ARE SOMEWHAT SIMILAR IN FUNCTION.)							
22.4	A. DEACTIVATION FURNACE INPUT CONVEYOR (ROCKET) B. DEACTIVATION FURNACE INPUT CONVEYOR (PROJECTILE) C. DEACTIVATION FURNACE INPUT CONVEYOR (MINE) D. DEACTIVATION FURNACE INPUT CONVEYOR (MORTAR) (ALL ITEMS ARE THE SAME EQUIPMENT.)	TRANSPORT DEMILED MUNITION ELEMENTS TO THE DEACTIVATION FURNACE.	REFER TO THE FOLLOWING BUILDING BLOCK FOR ANALYSIS: DFS - NO. 4					

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 22. MATERIAL HANDLING EQUIPMENT (MHE)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
22.5	ECC BYPASS CONVEYOR	TO PROVIDE A BYPASS OF THE ECC FOR NON-BURSTERED PROJECTILES.	MODE - MUNITIONS LOADED BACKWARDS BY UNPACK AREA PERSONNEL. CAUSE(S) A. HUMAN ERROR.	EQUIPMENT MUNITIONS LINE INTERRUPTION WHILE ERROR IS CORRECTED. ENTRY INTO THE PPD COULD RESULT IN DAMAGES TO THE HARDWARE AS ENUMERATED IN BB NO. 18.	FAILURE DETERRENCE TEMPLATES ARE BEING DESIGNED TO ASSURE PROPER ORIENTATION DURING THE LOADING OPERATION. A TILT TABLE FIXING PROJECTILE ORIENTATION FOR THE 155 MM AND 8-INCH PROJECTILES WILL BE USED.	1	4	4
			MODE - POWERED ROLLER FAILURE. CAUSE(S) A. ELECTRIC MOTOR FAILURE.	MUNITION LINE INTERRUPTION UNTIL FAILURE IS CORRECTED.	FAILURE DETERRENCE EACH CONVEYOR HAS A SENSOR TO DETECT MOTION. (REFERENCE BB NO. 35 SCS.)	1	4	4
22.6	A. PDF INPUT CONVEYOR (BURSTERED PROJECTILE) B. PDF INPUT CONVEYOR (NON-BURSTERED PROJECTILES) C. PDF INPUT CONVEYOR (MORTAR) (ALL TIMES ARE THE SAME EQUIPMENT.)	POWERED ROLLERS MOVE MUNITIONS TO THE PDF.	MODE - POWERED ROLLER FAILURE. CAUSE(S) A. ELECTRIC MOTOR FAILURE.	MUNITION LINE INTERRUPTION UNTIL FAILURE IS CORRECTED.	FAILURE DETERRENCE EACH CONVEYOR HAS A SENSOR TO DETECT MOTION. (REFERENCE BB NO. 35 SCS.)	1	4	4

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 22. MATERIAL HANDLING EQUIPMENT (MHE)

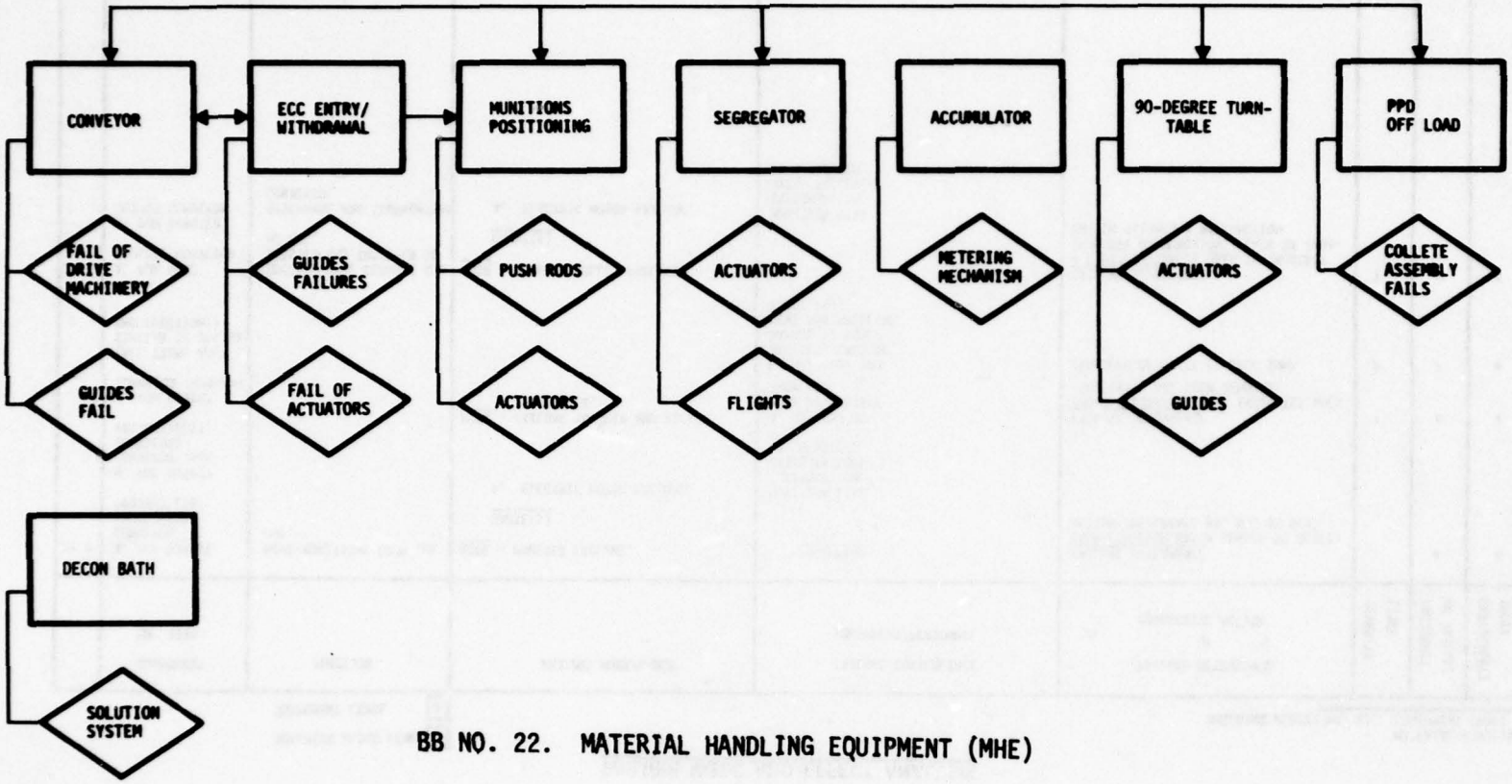
	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
22.7	A. PDF ACCUMULATOR (BURSTERED PROJECTILE) B. PDF ACCUMULATOR (NON-BURSTERED PROJECTILES) C. PDF ACCUMULATOR (MORTAR) (ALL ITEMS ARE THE SAME EQUIPMENT.)	POWERED BELT MOVES MUNITIONS TO THE PDF.	MODE - POWERED ROLLER FAILURE. CAUSE(S) A. ELECTRIC MOTOR FAILURE.	EQUIPMENT MUNITION LINE INTERRUPTION UNTIL FAILURE IS CORRECTED.	FAILURE DETERRENCE EACH CONVEYOR HAS A SENSOR TO DETECT MOTION. (REFERENCE BB NO. 35 SCS.)	1	4	4
			MODE - JAMMED METERING DEVICE. CAUSE(S) A. MISADJUSTMENT.	MUNITION LINE INTERRUPTION UNTIL FAILURE IS CORRECTED.	FAILURE DETERRENCE TV MONITOR WILL PERMIT VIEWING OF ACCUMULATOR.	1	4	4
22.8	A. 90-DEGREE TURN MACHINE (BURSTERED PROJECTILES) B. 90-DEGREE TURN MACHINE (NON-BURSTERED PROJECTILES) C. 90-DEGREE TURN MACHINE (MORTAR) (ALL ITEMS ARE THE SAME EQUIPMENT;)	MOTOR/CARRIAGE ROTATES MUNITION 90 DEGREES. POWERED ROLLERS MOVE MUNITIONS TO THE PDF BASE FIRST.	MODE - FAILURE TO ROTATE MUNITION. CAUSE(S) A. MOTOR FAILURE.	MUNITION LINE INTERRUPTION UNTIL FAILURE IS CORRECTED.	FAILURE DETERRENCE LIMIT SWITCHES INDICATE PROPER ROTATION. A LIMIT SWITCH IS USED TO INDICATE TRANSFER OF MUNITION: LACK OF TRANSFER INDICATION SIGNALS A MALFUNCTION.	1	3	3
			MODE - POWERED ROLLER FAILURE. CAUSE(S) A. ELECTRIC MOTOR FAILURE.	MUNITION LINE INTERRUPTION UNTIL FAILURE IS CORRECTED.				

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 22. MATERIAL HANDLING EQUIPMENT (MHE)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
22.9	A. PDF OUTPUT CONVEYOR (BURSTERED PROJECTILES) B. PDF OUTPUT CONVEYOR (NON-BURSTERED PROJECTILES) C. PDF OUTPUT CONVEYOR (PDRTAR) (ALL ITEMS ARE SIMILAR IN DESIGN AND FUNCTION.)	MOVE MUNITIONS FROM THE PDF.	MODE - POWERED FAILURE. CAUSE(S) A. ELECTRIC MOTOR FAILURE.	EQUIPMENT MUNITION LINE INTERRUPTION UNTIL FAILURE IS CORRECTED	FAILURE DETERRENCE EACH CONVEYOR HAS A SENSOR TO DETECT MOTION (REFERENCE BB. NO. 35 SCS).	1	4	4
			MODE - FAILURE TO GRIP AND PICKUP PROJECTILE.	A. MAY NOT REMOVE PROJECTILE FROM PPD.	FAILURE DETERRENCE PHOTO-ELECTRIC SENSOR INDICATES WHEN PROJECTILE HAS BEEN REMOVED.	1	4	4
				B. MAY DROP PROJECTILE, CAUSING DAMAGE TO EQUIPMENT AND SPILLING AGENT (H).	TRANSFER ACTIVITY IS OVER SUMP.	2	2	4
22.10	A. PDM NOSE CLOSURE CONVEYOR B. PDM BURSTER OUTPUT CONVEYOR	RECEIVE NOSE CLOSURE AND BURSTER AND TRANSFER TO HE ECC. DISCHARGE AND SEGREGATING CONVEYOR.	MODE - POWERED ROLLER FAILURE. CAUSE(S) A. ELECTRIC MOTOR FAILURE.	MUNITION LINE INTERRUPTION UNTIL FAILURE IS CORRECTED.	FAILURE DETERRENCE A LIMIT SWITCH IS USED TO INDICATE TRANSFER OF MUNITIONS: LACK OF INDICATION SIGNALS A MALFUNCTION.	1	4	4



BB NO. 22. MATERIAL HANDLING EQUIPMENT (MHE)

FMEA INFORMATION SOURCES

BB No. 22 MATERIAL HANDLING EQUIPMENT (MHE)

DRAWINGS/DOCUMENTS:

Marquardt Report #S-1304, Engineering Evaluation of CAMDS Munitions Demil Machinery Design, Phase 1, Evaluation, Volume 1, August 1974.

PERSONNEL REFERENCED:

Lt. Seeglitz

CRITERIA NOTES: (The following conveyors were not reviewed.)

- o Deactivation Furnace Output (MSS Rocket)
- o Deactivation Furnace Output (Burstered Projectiles)
- o Metal Parts Furnace Output (Burstered Projectiles)
- o Metal Parts Furnace Output (Non-Burstered Projectiles)
- o Deactivation Furnace Output (M23 Mine)
- o Deactivation Furnace Output (4.2-inch Mortar)
- o Metal Parts Furnace Output (4.2-inch Mortar)
- o HE Output (4.2-inch Mortar) - being designed
- o Mortar Body Output (4.2-inch Mortar) - being designed
- o Mine Output (M23 Mine) - being designed

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [X]

COMPONENT LEVEL [ ]

BUILDING BLOCK: NO. 23. FILTER SYSTEM (FIL)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
23.1	CHARCOAL FILTERING SYSTEM (11 LOCATIONS THROUGHOUT CAMDS)	TO PROVIDE ABSOLUTE FILTERING CAPABILITY OF AIR IN TOXIC AREAS (AND MAINTAIN NEGATIVE PRESSURE).	MODE - FILTERS PLUG OR ARE SATURATED. (REDUNDANT FILTERS IN ADS ONLY) CAUSE(S) A. EXCESSIVE BUILDUP OF AGENT AND/OR PARTICULATE IN THE HEPA FILTERS.	EQUIPMENT: SHUTDOWN AND MAINTENANCE (NORMALLY WOULD BE DONE ON A ROUTINE BASIS). PERSONNEL: LOSS OF NEGATIVE PRESSURE. POSSIBLE INFILTRATION OF TOXIC VAPORS INTO NONTOXIC AREA.	FAILURE DETERRENCE A HIGH ΔP ALARM IS PROVIDED FOR EACH FILTER BANK. LOSS OF FLOW OR NEGATIVE PRESSURE ALSO ACTUATES AN ALARM. ROUTINE MAINTENANCE TO BE PERFORMED ON A PERIODIC BASIS. THE EXCESSIVE BUILDUP WOULD OCCUR OVER A RELATIVELY LONG PERIOD OF TIME, THUS ALLOWING AMPLE TIME FOR OBSERVATION. IN ADDITION, ROUTINE MAINTENANCE (AS WELL AS AN EMERGENCY BACKUP) ALLOWS FOR MANUAL OPERATION AND USE OF OTHER FILTRATION BANKS IN THE SAME AREA. ALSO AGENT SAMPLING (WITH ALARM) IS PERFORMED BETWEEN THE CHARCOAL BANKS. THE THIRD (OR HIGHER) ORDER OF IN SERIES FAILURES REQUIRED RENDERS THIS MODE OF OCCURRING AS EXTREMELY UNLIKELY. CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	3	1	3

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [X]
COMPONENT LEVEL [X]

BUILDING BLOCK: NO. 23. FILTER SYSTEM (FIL)

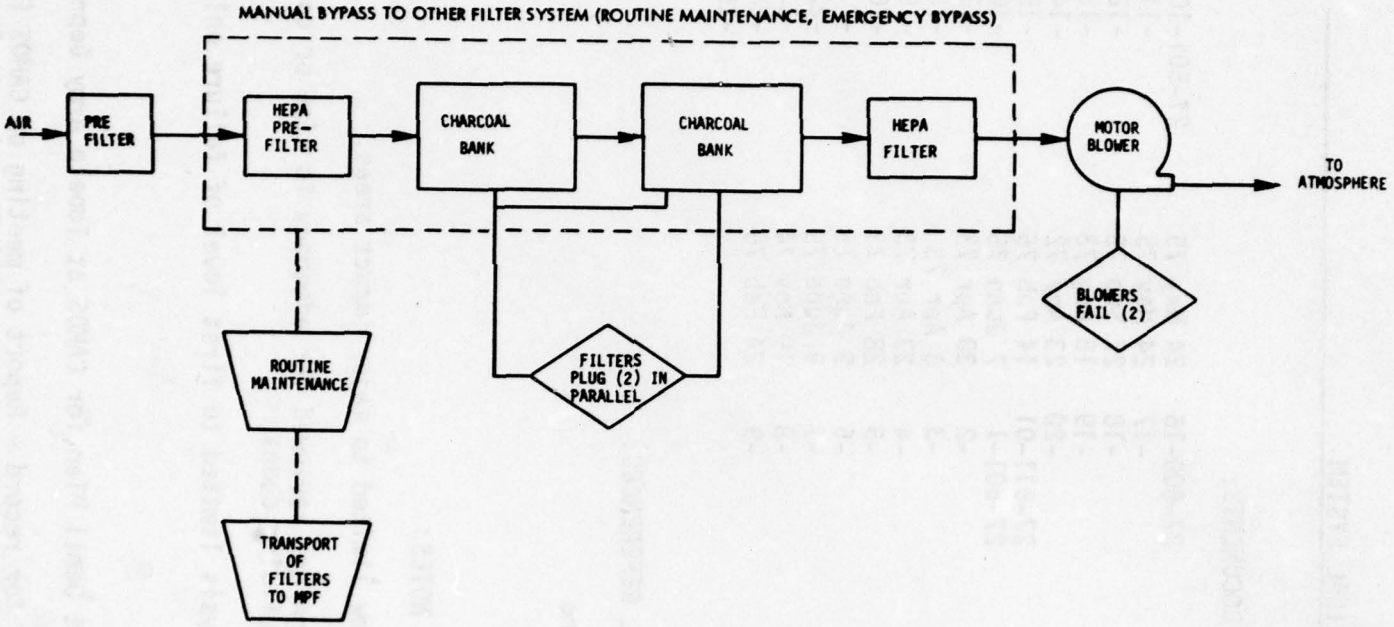
	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
23.1	CHARCOAL FILTERING SYSTEM (11 LOCATIONS THROUGHOUT CAMDS) (CONTINUED)		MODE - TOXIC MATERIAL RELEASED DURING ROUTINE MAINTENANCE. CAUSE(S) A. OPERATOR ERROR DURING REPAIR OR REPLACEMENT OF FILTERS.	PERSONNEL POSSIBLE RELEASE OF AGENT-LADEN CHARCOAL FILTERING MATERIAL TO THE OUTSIDE AREA.	FAILURE DETERRENCE SPECIAL SAFETY PROCEDURES AND EQUIPMENT ARE REQUIRED IN THE REPLACEMENT OF POTENTIALLY CONTAMINATED FILTERS. THE 333 CFM AND 2000 CFM FILTER UNITS EMPLOY THE "BAG IN/BAG OUT" CONCEPT IN WHICH THE FILTERS CAN BE REPLACED FROM OUTSIDE OF THE FILTER UNIT. POLYETHYLENE BAGS COMPLETELY ISOLATE THE FILTERS AND INTERIOR OF THE FILTER HOUSING DURING THE REPLACEMENT PROCEDURE. IN THE LARGER FILTER UNITS PERSONNEL MUST WEAR PROTECTIVE CLOTHING TO ENTER THE FILTER HOUSING, REMOVE THE USED FILTERS AND SEAL THEM IN POLYETHYLENE BAGS BEFORE REMOVING THEM FROM THE FILTER HOUSING. ALL USED FILTERS WILL BE TRANSPORTED IN SEALED BAGS TO THE METAL PARTS FURNACE FOR DISPOSAL. A MOTOR DISCONNECT SWITCH IS PROVIDED AT EACH FILTER UNIT TO ENABLE MAINTENANCE PERSONNEL TO INSURE THAT THE BLOWER CANNOT BE STARTED WHILE MAINTENANCE IS BEING ACCOMPLISHED. ALL FILTER UNITS WHICH SERVE NEGATIVE PRESSURE TOXIC ENCLOSURES ARE PROVIDED EMERGENCY ELECTRICAL POWER TO INSURE CONTAINMENT OF CONTAMINATION IN THE EVENT OF LOSS OF COMMERCIAL POWER. CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	2	2	4
			B. OPERATOR ERROR DURING TRANSPORT OF TOXIC CHARCOAL FILTER MATERIAL TO METAL PARTS FURNACE.	POSSIBLE RELEASE OF AGENT-LADEN CHARCOAL FILTERING MATERIAL TO THE OUTSIDE AREA.	FAILURE DETERRENCE CHARCOAL TO BE SEALED IN BAGS. PERSONNEL TO WEAR PROTECTIVE CLOTHING. DECON SOLUTION AND AGENT MONITORING WILL BE PROVIDED. CORRECTIVE ACTION: NONE RECOMMENDED.	2	2	4

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [X]
COMPONENT LEVEL [X]

BUILDING BLOCK: NO. 23. FILTER SYSTEM (FIL)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL		FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
	CHARCOAL FILTERING SYSTEM (11 LOCATIONS THROUGHOUT CAMDS) (CONTINUED)		MODE - LOSS OF FILTERING CAPABILITY CAUSE(S) A. BLOWER FAILURE.	EQUIPMENT SHUTDOWN AND MAINTENANCE (NORMALLY PERFORMED IN ANY CASE).	PERSONNEL LOSS OF NEGATIVE PRESSURE. POSSIBLE INFILTRATION OF VAPORS FROM THE TOXIC AREA INTO NONTOXIC AREAS.	FAILURE DETERRENCE THERE WOULD BE ADEQUATE WARNING SHOULD THE BLOWER FAIL. DUCTING AND MANUALLY OPERATED DAMPERS ARE PROVIDED BETWEEN FILTER UNITS, IN THE SAME AREA TO PROVIDE BACKUP CAPABILITY (NORMALLY FOR REPAIR OR REPLACEMENT BUT ALSO FOR AN EMERGENCY). IN ADDITION, LOSS OF FLOW OR NEGATIVE PRESSURE ACTUATES AN ALARM. FINALLY, NORMAL ROUTINE MAINTENANCE PROCEDURES SHOULD PRECLUDE THIS MODE FROM OCCURRING. A SERIES OF DETERRENCE FAILURES MUST OCCUR TO ALLOW THIS MODE. THUS, THIS FAILURE MODE CAUSING ANY TOXIC RELEASE IS REGARDED AS EXTREMELY REMOTE. CORRECTIVE ACTION NO FURTHER CORRECTIVE ACTION IS RECOMMENDED.	3	1	3



BB NO. 23. FILTER SYSTEM (FIL)

FMEA INFORMATION SOURCES

BB NO. 23 **ELECTRICAL SYSTEM**

DRAWINGS/DOCUMENTS:

27-500-1	24 May 75	27-500-16	24 May 75	27-501-10	24 Feb 75
-2	24 May 75	-17	24 May 75	-11	20 Feb 75
-3	27 May 75	-18	27 Sep 73	-12	9 June 75
-4	27 May 75	-19	15 Aug 73	-13	17 Dec 75
-5	27 May 75	-20	23 Apr 72	-14	16 Dec 74
-6	27 May 75	27-511-01	14 Feb 75	-15	16 Dec 74
-7	27 May 75	27-501-1	7 June 75	-16	6 Jan 74
-8	27 May 75	-2	30 Apr 73	-17	2 Oct 72
-9	27 May 75	-3	3 Apr 73	-18	3 Dec 73
-10	27 May 75	-4	23 Apr 73	-19	14 Mar 75
-11	9 June 75	-5	28 Feb 73	-20	4 Feb 75
-12	20 May 75	-6	9 June 75	-21	30 Dec 74
-13	20 May 75	-7	9 June 75	-22	10 Sep 74
-14	24 May 75	-8	19 Nov 74	-23	18 June 75
-15	7 June 75	-9	24 Feb 75	-24	30 May 75
				-25	3 July 75

PERSONNEL REFERENCED:

D. Bodrero

L. Selin

CRITERIA NOTES:

- Review limited to major impact areas.
- Design not reviewed for adequacy in size or conformity to building codes.
- Analysis limited to first level of failure only.

OTHER:

- Draft Demil Plan for CAMDS at Tooele Army Depot
- Memo for record - Report of meeting on CAMDS Electrical and Control Interfaces - SAREA-DM, 25 July 75, J. S. Cauller
- Disposition AMXTE-AEO, CAMDS Electrical System, 14 July 1975.

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [X]
COMPONENT LEVEL [ ]

BUILDING BLOCK: NO. 24. MORTAR DEMIL MACHINE (MDR)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
24.0	MORTAR DEMIL MACHINE	SEPARATE MORTAR FUSE AND BURSTER.						
24.1	INTERFACING BUILDING BLOCKS							
	NO. 2 ECC	EXPLOSIVE/AGENT CONTAINMENT.						
	NO. 9 EHM	HYDRAULIC PRESSURE SUPPLY.						
	NO. 22 MHE	ECC INPUT CONVEYOR HE OUTPUT CONVEYOR MORTAR BODY OUTPUT CONVEYOR.						
	NO. 23 FIL	FILTER SYSTEM.						
	NO. 26 PIP	PIPING.						
	NO. 30 CTV	CLOSED CIRCUIT TELEVISION						
	NO. 31 COM	REMOTE AUDIO MONITOR.						
	NO. 35 SCS	SITE CONTROLS SYSTEM.						

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 24. MORTAR DEMIL MACHINE (MDR)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
24.2	MORTAR ECC INPUT CONVEYOR	RECEIVE MUNITION FROM UNPACK AREA PERSONNEL. EXTENDS INTO THE ECC AND MATES WITH AN INTERMEDIATE CONVEYOR OR THE DEMIL MACHINE, TRANSPORTS THE MUNITION TO THE NEXT HARDWARE ITEM, AND RETRACTS TO CLEAR THE ECC ALLOWING ITEM IN DOOR CLOSURE.	MODE - MUNITIONS LOADED BACKWARDS BY UNPACK AREA PERSONNEL. CAUSE(S) HUMAN ERROR.	EQUIPMENT MUNITIONS LINE INTERRUPTION WHILE ERROR IS CORRECTED.	FAILURE DETERRENCE CONVEYOR MOUNTED SENSOR DETECTS PROPER ORIENTATION.	1	4	4
			MODE - FAILURE OF THE CONVEYOR TO MOVE IN THE ECC AND MATE WITH THE INTERMEDIATE CONVEYOR OR DEMIL MACHINE. CAUSE(S) FAILURE OF THE CONVEYOR POSITIONING MECHANISM.	EQUIPMENT FAILURE TO MATE CORRECTLY WILL NOT ALLOW THE NEXT STEP IN THE PROCESS TO BEGINE.	FAILURE DETERRENCE LIMIT SWITCHES INDICATE PROPER ALIGNMENT AND MATING.	1	4	4
			MODE - FAILURE TO CONVEY MUNITION. CAUSE(S) ACTUATION MOTOR FAILURE.	EQUIPMENT MUNITIONS LINE INTERRUPTION WHILE FAILURE IS CORRECTED.	FAILURE DETERRENCE DOWNSTREAM CONVEYOR DETECTS ARRIVAL OF MUNITION WITH SENSORS INSURING DETECTION OF MOTOR FAILURE.	1	4	4
			MODE - FAILURE OF CONVEYOR TO RETRACT FROM THE ECC. CAUSE(S) FAILURE OF THE CONVEYOR POSITIONING MECHANISM.	EQUIPMENT FAILURE TO RETRACT CORRECTLY WILL NOT ALLOW THE NEXT STEP IN THE PROCESS TO BEGIN.	FAILURE DETERRENCE LIMIT SWITCHES INDICATE PROPER RETRACTION.	1	4	4
			MODE - POSSIBLE CONTAMINATION OF THE CONVEYOR AT THE INTERMEDIATE CONVEYOR OR DEMIL MACHINE CONTACT POINT.	EQUIPMENT CONTAMINATED HARDWARE (CONVEYORS) ARE RETRACTED INTO THE UNPACK AREA (AIRLOCK).	FAILURE DETERRENCE THE AIRLOCK AREA IS MAINTAINED AT A NEGATIVE PRESSURE RELATIVE TO THE BALANCE OF THE UNPACK AREA. AGENT SENSORS ARE LOCATED IN THE UNPACK AREA. STANDARD OPERATING PROCEDURES FOR PERSONNEL MINIMIZE POTENTIAL FOR EXPOSURE.	2	4	8

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 24. MORTAR DENIL MACHINE (MDR)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
24.2 CONT.	HYDRAULIC PUSH CYLINDER	POSITION MORTAR FOR PULLING FUSE AND BURSTER.	MODE - FAILURE TO PROPERLY POSITION THE MORTAR.	EQUIPMENT INABILITY TO PULL FUSE AND BURSTER FROM MORTAR.	FAILURE DETERRENCE POSITION SENSOR WILL SENSE PROPER LOCATION OF MORTAR. IF IT IS NOT PROPERLY LOCATED, THE CONTROL SYSTEM WILL AUTOMATICALLY STOP ALL PROCESSING OPERATIONS.	1	3	3
24.3	MORTAR CLAMP	HOLD MORTAR FOR PULLING FUSE AND BURSTER.	MODE - FAILURE TO CLAMP. CAUSE(S) ACTUATOR FAILURE, OR LOW HYDRAULIC PRESSURE.	EQUIPMENT INABILITY TO PULL FUSE AND BURSTER FROM MORTAR.	FAILURE DETERRENCE POSITION SENSOR WILL SENSE CLOSED POSITION OF CLAMP. IF IT IS NOT PROPERLY LOCATED, THE CONTROL SYSTEM WILL AUTOMATICALLY STOP ALL PROCESSING OPERATIONS.	1	3	3
		RELEASE MORTAR BODY TO OUTPUT CONVEYOR AFTER PULLING FUSE AND BURSTER.	MODE - HANG-UP OF CLAMP. CAUSE(S) ACTUATOR OR CONTROL SYSTEM FAILURE.	EQUIPMENT POSITION WILL NOT BE EMPTY FOR NEXT MORTAR.	FAILURE DETERRENCE THE ABOVE POSITION SENSOR WILL SENSE THE RELEASE OF THE CLAMP. IF IT IS NOT PROPERLY LOCATED, THE CONTROL SYSTEM WILL AUTOMATICALLY STOP ALL PROCESSING OPERATIONS.	1	3	3

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 24. MORTAR DENIL MACHINE (MDR)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
24.4	FUSE AND BURSTER PULL MECHANISM	REMOVE FUSE AND BURSTER FROM MORTAR.	MODE - FAILURE TO GRIP FUSE. CAUSE(S) MECHANISM FAILURE OR NONSTANDARD FUSE.	EQUIPMENT PRODUCTION STOPPAGE.	FAILURE DETERRENCE A SENSOR WILL DETECT REMOVAL OF THE FUSE AND BURSTER FROM THE MORTAR. IF IT DOES NOT INDICATE SUCCESSFUL REMOVAL, THE CONTROL SYSTEM WILL AUTOMATICALLY STOP ALL PROCESSING OPERATIONS.	1	3	3
			MODE - FAILURE TO PULL. CAUSE(S) ACTUATOR FAILURE.	EQUIPMENT PRODUCTION STOPPAGE.	FAILURE DETERRENCE A SENSOR WILL DETECT REMOVAL OF THE FUSE AND BURSTER FROM THE MORTAR. IF IT DOES NOT INDICATE SUCCESSFUL REMOVAL, THE CONTROL SYSTEM WILL AUTOMATICALLY STOP ALL PROCESSING OPERATIONS.	1	3	3
			MODE - FAILURE TO PULL. CAUSE(S) JAMMED FUSE AND BURSTER.	EQUIPMENT WILL REQUIRE REMOVAL FROM THE PROCESSING LINE EITHER BY ENTRY INTO THE ECC OR SPECIALLY CONTROLLED SEQUENCE OUT OF THE ECC ON THE CONVEYORS TO A LOCATION THAT IS ACCESSIBLE.	CORRECTIVE ACTION SPECIAL OPERATING PROCEDURE FOR REMOVAL OF MORTAR.	1	3	3

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 24. MORTAR DENIL MACHINE (MDM)

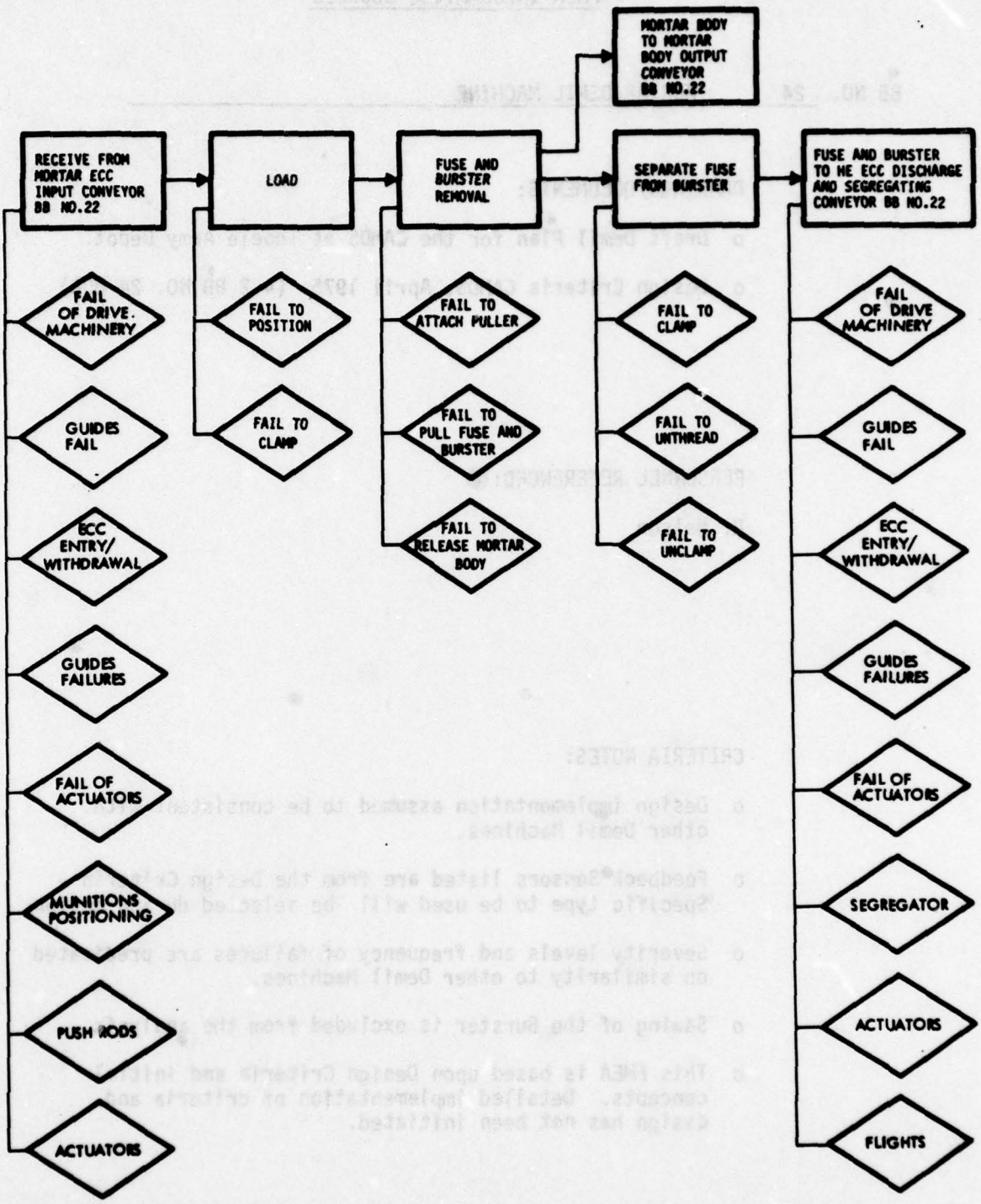
	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
24.5	FUSE RELEASE MECHANISM	RELEASE FUSE FROM FUSING HEAD.	MODE - FAILURE TO RELEASE. CAUSE(S) MECHANISM FAILURE.	EQUIPMENT INABILITY TO PULL FUSE AND BURSTER.	FAILURE DETERRENCE SENSORS WILL DETECT THE RELEASE AND IF THE FUSE IS IN THE PROPER POSITION FOR SEPARATION FROM THE BURSTER. IF IT DOES NOT INDICATE THE PROPER CONDITIONS, THE CONTROL SYSTEM WILL AUTOMATICALLY STOP ALL PROCESSING.	1	3	3
24.6	CLAMP	HOLD BURSTER OR FUSE DURING SEPARATION AND RELEASE TO HE OUTPUT CONVEYOR AFTER SEPARATION.	MODE - FAILURE TO HOLD FOR SEPARATION. MODE - FAILURE TO RELEASE AFTER SEPARATION.	EQUIPMENT INABILITY TO SEPARATE BURSTER FROM FUSE. EQUIPMENT MAKEUP OF BURSTER OR FUSE IN MACHINE.	FAILURE DETERRENCE A SENSOR WILL DETECT THE CLOSURE AND RELEASE OF THE JAWS. IF IT DOES NOT INDICATE PROPER CONDITIONS, THE CONTROL SYSTEM WILL AUTOMATICALLY STOP ALL PROCESSING OPERATIONS.	1	3	3
24.7	FUSE/BURSTER UNCOUPLER	UNTHREAD FUSE FROM BURSTER.	MODE - FAILURE TO UNTHREAD. CAUSE(S) UNCOUPLER FAILURE OR JAMMED THREADS.	EQUIPMENT INABILITY TO SEPARATE BURSTER FROM FUSE.	FAILURE DETERRENCE A SENSOR WILL DETECT THE SEPARATION OF THE FUSE FROM THE BURSTER. IF IT DOES NOT INDICATE SEPARATION, THE CONTROL SYSTEM WILL AUTOMATICALLY STOP ALL PROCESSING OPERATIONS.	1	3	3

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK NO. 24. MORTAR DEMIL MACHINE (MDR)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
24.8	A. H.E. ECC DISCHARGE AND SEGREGATING CONVEYOR (MORTAR) B. MORTAR ECC DISCHARGE CONVEYOR	EXTENDS INTO THE ECC AND MATES WITH AN INTERMEDIATE CONVEYOR OR THE DEMIL MACHINE, TRANSPORTS THE MUNITION COMPONENTS TO THE NEXT CONVEYOR AND RETRACTS TO CLEAR THE ECC ALLOWING ITEM OUT DOOR CLOSURE. ITEM B ALSO SEGREGATES PORTIONS OF THE MUNITIONS.	MODE - FAILURE OF THE CONVEYOR TO MOVE IN THE ECC AND MATE WITH THE INTERMEDIATE CONVEYOR OR DEMIL MACHINE. CAUSE(S) FAILURE OF THE CONVEYOR POSITIONING MECHANISM.	EQUIPMENT FAILURE TO MATE CORRECTLY WILL NOT ALLOW THE NEXT STEP IN THE PROCESS TO BEGIN.	FAILURE DETERRENCE LIMIT SWITCHES INDICATE PROPER ALIGNMENT AND MATING.	1	4	4
			MODE - FAILURE TO CONVEY MUNITION. CAUSE(S) ACTUATION MOTOR FAILURE.	EQUIPMENT MUNITIONS LINE INTERRUPTION WHILE ERROR IS CORRECTED.	FAILURE DETERRENCE EACH CONVEYOR HAS A SENSOR TO DETECT MOTION. (REFERENCE BB NO. 35 SCS)	1	4	4
			MODE - FAILURE OF CONVEYOR TO RETRACT FROM THE ECC. CAUSE(S) FAILURE OF THE CONVEYOR POSITIONING MECHANISM.	EQUIPMENT FAILURE TO RETRACT CORRECTLY WILL NOT ALLOW THE NEXT STEP IN THE PROCESS TO BEGIN.	FAILURE DETERRENCE LIMIT SWITCHES INDICATE PROPER RETRACTION.	1	4	4
			MODE - POTENTIAL FIRE FROM EXPLOSIVE AND/OR EXPLOSIVE CHIPS GENERATED DURING PROCESSING.	PERSONNEL POTENTIAL AGENT RELEASE TO ATMOSPHERE AND/OR PERSONNEL EXPOSURE.	FAILURE DETERRENCE NO SOURCE OF IGNITION HAS BEEN IDENTIFIED FROM THE CONVEYORS. THEREFORE, THIS FAILURE MODE REPRESENTS AT LEAST A SECOND ORDER OCCURRENCE. A MAINTENANCE PROGRAM WILL REMOVE THE MATERIAL.	3	1	3



BB NO. 24. MORTAR DEMIL MACHINE (MDM)

FMEA INFORMATION SOURCES

BB NO. 24 MORTAR DEMIL MACHINE

DRAWINGS/DOCUMENTS:

- Draft Demil Plan for the CAMDS at Tooele Army Depot.
- Design Criteria CAMDS, April 1975. (4.2 BB NO. 24 MOR)

PERSONNEL REFERENCED:

R. Nelson

CRITERIA NOTES:

- Design implementation assumed to be consistent with other Demil Machines.
- Feedback Sensors listed are from the Design Criteria - Specific type to be used will be selected during design.
- Severity levels and frequency of failures are predicated on similarity to other Demil Machines.
- Sawing of the Burster is excluded from the analysis.
- This FMEA is based upon Design Criteria and initial concepts. Detailed implementation of criteria and design has not been initiated.

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [X]
COMPONENT LEVEL [X]

(MIN)

BUILDING BLOCK: NO. 25. MINE DEMIL MACHINE

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
25.0	MINE DEMIL MACHINE	PUNCH AND DRAIN AGENT, PUNCH AND DRAIN VX AGENT, REMOVE BURSTER.		EQUIPMENT				
25.1	INTERFACING BUILDING BLOCKS							
	BB NO. 2 ECC	EXPLOSIVE/AGENT CONTAINMENT.						
	BB NO. 9 EHM	HYDRAULIC PRESSURE SUPPLY.						
	BB NO. 22 MHE	MINE ECC INPUT CONVEYOR.						
		MINE OUTPUT CONVEYOR.						
		MINE ECC DISCHARGE AND SEGREGATING CONVEYOR.						
	BB NO. 23 FIL	FILTER SYSTEM.						
	BB NO. 26 PIP	PIPING.						
	BB NO. 30 CTV	REMOTE VISUAL MONITOR.						
	BB NO. 31 COM	REMOTE AUDIO MONITOR.						
	BB NO. 35 SCS	DEMIL CONTROLS.						
25.2	MINE ECC INPUT CONVEYOR	RECEIVE MUNITION FROM UNPACK AREA PERSONNEL. EXTENDS INTO THE ECC AND MATES WITH AN INTERMEDIATE CONVEYOR, OR THE DEMIL MACHINE, TRANSPORTS THE MUNITION TO THE NEXT HARDWARE ITEM, AND RETRACTS TO CLEAR THE ECC, ALLOWING ITEM IN DOOR CLOSURE.	MODE - MUNITIONS LOADED BACKWARDS BY UNPACK AREA PERSONNEL. CAUSE(S) A. HUMAN ERROR.	MUNITIONS LINE INTERRUPTION WHILE ERROR IS CORRECTED. FAILURE TO MATE CORRECTLY WILL NOT ALLOW THE NEXT STEP IN THE PROCESS TO BEGIN.	FAILURE DETERRENCE A CONVEYOR MOUNTED SENSOR DETECTS PROPER ORIENTATION. THE HANDLE ON THE MINE IS KEYED TO A RECEIVER ON THE CONVEYOR, MAKING IMPROPER LOADING HIGHLY UNLIKELY. A MICROSWITCH CONFIRMS THE POSITION. FAILURE DETERRENCE LIMIT SWITCHES INDICATE PROPER ALIGNMENT AND MATING.	1 1	4 4	4 4

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

(MIN)

BUILDING BLOCK: NO. 25. MINE DEMIL MACHINE

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
25.2	MINE ECC INPUT CONVEYOR (CONTINUED)		MODE - FAILURE TO CONVEY MUNITION. CAUSE(S) A. ACTUATION MOTOR FAILURE.	EQUIPMENT MUNITION LINE INTERRUPTION WHILE FAILURE IS CORRECTED.	FAILURE DETERRENCE DOWNSTREAM CONVEYOR DETECTS ARRIVAL OF MUNITION WITH SENSORS INSURING DETECTION OF MOTOR FAILURE.	1	4	4
			MODE - FAILURE OF CONVEYOR TO RETRACT FROM THE ECC. CAUSE(S) A. FAILURE OF THE CONVEYOR POSITIONING MECHANISM.	FAILURE TO RETRACT CORRECTLY WILL NOT ALLOW THE NEXT STEP IN THE PROCESS TO BEGIN.	FAILURE DETERRENCE LIMIT SWITCHES INDICATE PROPER RETRACTION.	1	4	4
			MODE - POSSIBLE CONTAMINATION OF THE CONVEYOR AT THE INTERMEDIATE CONVEYOR OR DEMIL MACHINE CONTACT POINT.	CONTAMINATED HARDWARE (CONVEYORS) ARE RETRACTED INTO THE UNPACK AREA (AIRLOCK).	FAILURE DETERRENCE THE AIRLOCK AREA IS MAINTAINED AT A NEGATIVE PRESSURE RELATIVE TO THE BALANCE OF THE UNPACK AREA. AGENT SENSORS ARE LOCATED IN THE UNPACK AREA. STANDARD OPERATING PROCEDURES FOR PERSONNEL MINIMIZE POTENTIAL FOR EXPOSURE.	2	4	8
25.3	HYDRAULIC CLAMP	LIFT MINE OFF INPUT CONVEYOR. HOLD MINE DURING PUNCH, DRAIN AND DISASSEMBLY OPERATIONS.	MODE - FAILURE TO LIFT MINE OFF INPUT CONVEYOR. CAUSE(S) A. ACTUATOR FAILURE.	PRODUCTION STOPS.	FAILURE DETERRENCE SWITCH ON INPUT CONVEYOR INDICATES WHEN MINE LEAVES THE CONVEYOR. IF THE MINE IS NOT REMOVED ON SCHEDULE THE CONTROL SYSTEM STOPS PROCESSING OPERATIONS.	1	2	2
			MODE - FAILURE TO CLAMP MINE IN PLACE OR MINE DENTED AT THE DRAIN POINT.	MINE COULD LEAVE MACHINE WHEN PUNCHING IS ATTEMPTED, CAUSING MACHINE DAMAGE.	FAILURE DETERRENCE WHEN THE MINE IS PROPERLY SECURED, IT IS SEATED ON BUTYL RUBBER. THE LOWER JAW HAS A DRAIN HOLE TO THE AGENT REMOVAL PUMP. THE PRESSURE ON THIS LINE IS CHECKED BY THE CONTROL SYSTEM. IF IT SHOWS A VACUUM, THE JAWS ARE	1	2	2

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

(MIN)

BUILDING BLOCK: NO. 25. MINE DEMIL MACHINE

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
25.3	HYDRAULIC CLAMP (CONTINUED)			EQUIPMENT SEAL ON AGENT DRAIN WOULD LEAK AGENT INSIDE THE ECC. VAPORS WOULD BE REMOVED BY THE FILTER SYSTEM. BURSTER REMOVAL WILL NOT BE *POSSIBLE - MAY* DAMAGE PULL EQUIPMENT AND/OR DROP MINE.	ASSUMED TO BE CLAMPED AND PROCESSING PROCEEDS. IF A VACUUM DOES NOT EXIST, THE CONTROL SYSTEM STOPS THE PROCESSING OPERATION. MINES ARE INSPECTED IN THE UNPACK AREA FOR MECHANICAL DAMAGE (DENTS, ETC.). TO CAUSE A PROBLEM THE DENT WOULD HAVE TO BE IN A SPECIFIC SPOT AND WOULD HAVE TO ESCAPE DETECTION DURING INSPECTION. THE DENT WOULD ALSO HAVE TO BE LARGE ENOUGH TO PREVENT SEALING VIA THE BUTYL RUBBER DRAIN PUNCH SEAL.			
25.4	HYDRALIC PUNCHES	PUNCH A HOLE IN THE TOP (VENT) AND TURN 90° AND DIMPLE OUT OF THE MINE (DRAIN).	MODE - FAILURE TO PUNCH CAUSE(S) A. ACTUATOR FAILURE.	INABILITY TO DRAIN STOPPING PRODUCTION.	FAILURE DETERRENCE THE AMOUNT OF AGENT REMOVED IS SENSED BY A LEVEL SENSOR.	1	2	2
			MODE - FAILURE TO RETRACT PUNCH (COMPLETELY). CAUSE(S) A. ACTUATOR FAILURE.	POSSIBLE DAMAGE TO MACHINE (PUNCH BREAKAGE).	FAILURE DETERRENCE VENT PUNCH STATUS CAN BE OBSERVED ON REMOTE TV. IMPROPER DRAINING WILL INDICATE A FAILURE OF THE DRAIN PUNCH.	2	2	4
25.5	AGENT DRAIN SYSTEM-DEMISTER, SURGE TANK, VACUUM PUMP, DIAPHRAGM TYPE AGENT PUMP, LEVEL SENSORS, SOLENOID VALVES	DRAIN AGENT FROM MINE AND PUMP THROUGH PIPING TO ADS.	MODE - FAILURE OF THE VACUUM PUMP TO PULL SUFFICIENT VACUUM.	PROCESSING OF THE LINE WILL CEASE.	FAILURE DETERRENCE PUNCHES WILL NOT OPERATE BECAUSE SENSORS WILL NOT DETECT A VACUUM WHEN THE JAWS CLOSE.	1	2	2

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

(MIN)

BUILDING BLOCK: NO. 25. MINE DEMIL MACHINE

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
25.5	AGENT DRAIN SYSTEM-DEMISTER, SURGE TANK, VACUUM PUMP, DIAPHRAGM TYPE AGENT PUMP, LEVEL SENSORS, SOLENOID VALVED (CONTINUED)		MODE - AGENT PUMP INOPERATIVE. CAUSE(S) A. DIAPHRAGM FAILURE, MECHANICAL FAILURE, ETC.	EQUIPMENT DRAINAGE WILL PROCEED AT A SLOWER RATE, AND THE AGENT WILL ACCUMULATE IN THE ECC AND NOT BE TRANSFERRED TO THE ADS.	FAILURE DETERRENCE THE AGENT LEVEL SENSOR WILL DETECT THE CONTINUED PRESENCE OF AGENT. PRESSURE SWITCH INDICATES WHEN ALL THE AGENT IS REMOVED.	1	2	2
			MODE - SOLENOID VALVES (4) FAIL OPEN OR CLOSED.	AGENT WILL NOT DRAIN.	FAILURE DETERRENCE LEVEL SENSOR WILL INDICATE FAILURE AND THE SYSTEM AUTOMATICALLY SHUTS DOWN.	1	2	2
			MODE - LEVEL SENSOR FAILS INOPERATIVE OR GIVES AN INACCURATE INDICATION.	THIS FAILURE MODE IS EQUIVALENT TO THE SENSOR SENSING A FAILURE AND WOULD RESULT IN THE AUTOMATIC SHUTDOWN OF THE LINE.	FAILURE DETERRENCE PERIODIC RECALIBRATION AND MAINTENANCE.	1	2	2
25.6	BOOSTER RETAINER RING REMOVAL DEVICE	REMOVE BOOSTER RETAINING RING.	MODE - FAILURE OF THE COLLET TO REMOVE THE RETAINING RING. CAUSE(S) A. WEAR OR HYDRAULIC FAILURE.	THE PROCESS CANNOT PROCEED TO THE NEXT STEP.	FAILURE DETERRENCE RING REMOVAL IS INDICATED BY A MICRO-SWITCH. THE COLLET WILL BE INSPECTED DAILY DURING THE MAINTENANCE INTERVAL AND WILL BE REPLACED WHEN ANY WEAR IS NOTED.	1	2	2

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

(MIN)

BUILDING BLOCK: NO. 25. MINE DEMIL MACHINE

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
25.7	BOOSTER REMOVAL DEVICE	REMOVE BOOSTER.	MODE - FAILURE TO REMOVE THE BOOSTER. CAUSE(S) A. LACK OF PROPER PRESSURE SEAL OR HYDRAULIC SYSTEM FAILURE.	EQUIPMENT THE PROCESS CANNOT PROCEED TO THE NEXT STEP. IF REMOVED AND IT ENTERS A FURNACE WITH THE BURSTER, THE TOTAL CHARGE WILL BE TOO HIGH (DAMAGE TO THE FURNACE).	FAILURE DETERRENCE BOOSTER REMOVAL IS VERIFIED VIA A SENSOR ON THE OUTPUT CHUTE/CONVEYOR.	1	2	2
25.8	ADAPTOR PLATE REMOVAL DEVICE	REMOVE ADAPTOR PLATE.	MODE - DEVICE DOES NOT MOVE FORWARD TO CONTACT THE ADAPTOR. CAUSE(S) A. ACTUATOR OR HYDRAULIC FAILURE. MODE - GUIDE PIN/ALIGNMENT PIN DO NOT PROPERLY ENGAGE THE ADAPTOR. CAUSE(S) A. WEAR OR MECHANICAL DAMAGE. MODE - FAILURE TO TURN ADAPTOR. CAUSE(S) A. HYDRAULIC MOTOR FAILURE OR JAMMED ADAPTOR.	THE ADAPTOR WILL NOT BE REMOVED, AND THE BURSTER, THEREFORE, CANNOT BE REMOVED EITHER.	FAILURE DETERRENCE THE REMOVAL DEVICE MAKES 8 TO 10 REVOLUTIONS AND ONLY 2 OR 3 ARE REQUIRED. THE ADAPTOR REMOVAL HEAD HAS A SPRING LOADED DEVICE WHICH CAUSES THE REMOVED ADAPTER PLATE TO FALL OFF THE HEAD AND INTO A CHUTE. AT THIS POINT THE SWITCH ON THE OUTPUT CONVEYOR SENSES ITS PRESENCE (I.E., SUCCESSFUL REMOVAL). GUIDE PIN/ALIGNMENT PIN WILL BE INSPECTED AT REGULAR INTERVALS.	1	3	3
25.9	BURSTER PULL TUBE	PUSH OUT MAIN CHARGE.	MODE - BURSTER IS NOT REMOVED. CAUSE(S) A. FAILURE TO EXTEND DUE TO ACTUATOR FAILURE.	BURSTER IS NOT REMOVED.	FAILURE DETERRENCE PRESENCE OF THE BURSTER IS MONITORED ON THE CONVEYOR BELT VIA SWITCHES. ALSO LIMIT SWITCHES ON THE PULL TUBE INDICATE BOTH EXTREMES OF ITS STROKE.	1	2	2

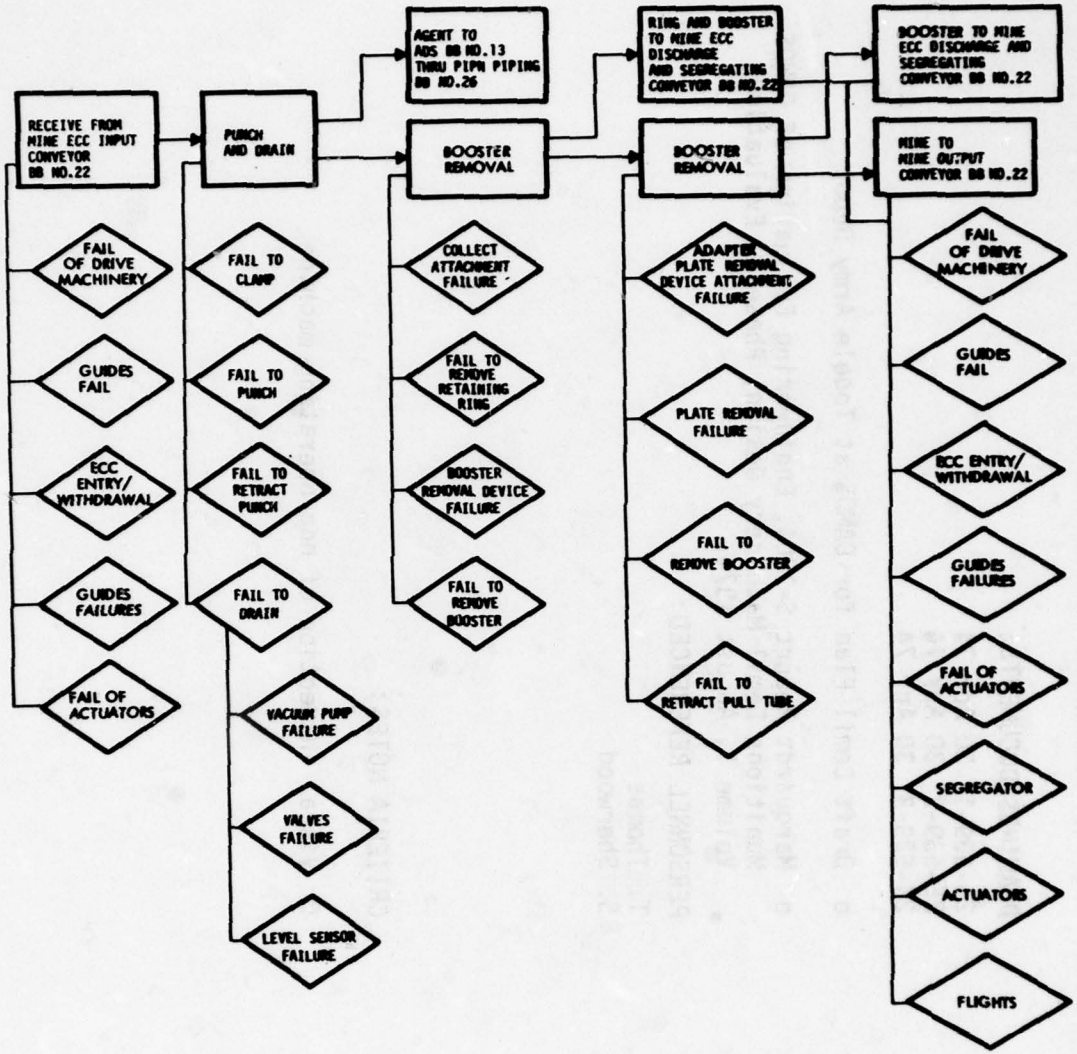
FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

(MIN)

BUILDING BLOCK: NO. 25. MINE DEMIL MACHINE

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
25.10	MINE ECC DISCHARGE AND SEGREGATING CONVEYOR	EXTENDS INTO THE ECC AND MATES WITH AN INTERMEDIATE CONVEYOR OR THE DEMIL MACHINE, TRANSPORTS THE MUNITION COMPONENTS TO THE NEXT CONVEYOR AND RETRACTS TO CLEAR THE ECC, ALLOWING ITEM OUT DOOR CLOSURE. ALSO SEGREGATES PORTIONS OF THE MUNITIONS.	MODE - FAILURE OF THE CONVEYOR TO MORE IN THE ECC AND MATE WITH THE INTERMEDIATE CONVEYOR OR DEMIL MACHINE. CAUSE(S) A. FAILURE OF THE CONVEYOR POSITIONING MECHANISM.	EQUIPMENT FAILURE TO MATE CORRECTLY WILL NOT ALLOW THE NEXT STEP IN THE PROCESS TO BEGIN.	FAILURE DETERRENCE LIMIT SWITCHES INDICATE PROPER ALIGNMENT AND MATING.	1	4	4
			MODE - FAILURE TO CONVEY MUNITION. CAUSE(S) A. ACTUATION MOTOR FAILURE.	MUNITIONS LINE INTERRUPTION WHILE ERROR IS CORRECTED.	FAILURE DETERRENCE EACH CONVEYOR HAS A SENSOR TO DETECT MOTION (REFERENCE BB NO. 35 SCS).	1	4	4
			MODE - FAILURE OF CONVEYOR TO RETRACT FROM THE ECC. CAUSE(S) A. FAILURE OF THE CONVEYOR POSITIONING MECHANISM.	FAILURE TO RETRACT CORRECTLY WILL NOT ALLOW THE NEXT STEP IN THE PROCESS TO BEGIN.	FAILURE DETERRENCE LIMIT SWITCHES INDICATE PROPER RETRACTION.	1	4	4
			MODE - POTENTIAL FIRE FROM EXPLOSIVE AND/OR EXPLOSIVE CHIPS GENERATED DURING PROCESSING.	POTENTIAL AGENT RELEASE TO ATMOSPHERE AND/OR PERSONNEL EXPOSURE.	FAILURE DETERRENCE NO SOURCE OF IGNITION HAS BEEN IDENTIFIED FROM THE CONVEYORS. THEREFORE, THIS FAILURE MODE REPRESENTS AT LEAST A SECOND ORDER OCCURRENCE. A MAINTENANCE PROGRAM WILL REMOVE THE MATERIAL.	3	1	3



BB NO. 25. MINE DEMIL MACHINE (MDN)

FMEA INFORMATION SOURCES

BB NO. 25 MINE DEMIL MACHINE

DRAWINGS/DOCUMENTS:

25-539-1 30 Apr 74
25-539-2 30 Apr 74
25-539-3 30 Apr 74

- o Draft Demil Plan for CAMDS at Tooele Army Depot
- o Marquardt Report S-1304, Engineering Evaluation of CAMDS Munitions Demil Machinery Design, Phase 1, Evaluation, Volume 1, August 1974.

PERSONNEL REFERENCED:

T. Thomas
S. Sherwood

CRITERIA NOTES:

- O Visual inspection of non-operating machine

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [X]
COMPONENT LEVEL [ ]

BUILDING BLOCK: NO. 26. PIPING (PIP)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
26.0	PIPING (PIP)	CONVEY AIR, STEAM, AGENT (GB/VX) DECON SOLUTIONS, SCRUBBER BRINE, AND FUEL OIL WITHIN THE CAMDS FACILITY.		EQUIPMENT				
26.1	AGENT PIPING	TRANSPORT AGENT FROM THE ECC, PPD, AND BIF TO THE ADS FOR DISPOSAL.	MODE - AGENT LEAKAGE TO THE FILTER SYSTEM.	NO SERIOUS CONSEQUENCE IN THE ABSENCE OF A SECOND FAILURE. THE AGENT ENTERS THE FILTER SYSTEM.	FAILURE DETERRENCE THE PIPING USED IS COAXIAL. (SCHEDULE 80 INSIDE, 3-INCH DIAMETER OUTSIDE, HEATED AND INSULATED, INSIDE PIPE IS WELDED.) AGENT IS PUMPED TO A STAND PIPE. DRAINAGE IS VIA GRAVITY. DETECTORS MONITOR THE SHROUD PIPING FOR LEAKS.	1	1	1
			MODE - FAILURE TO POSITION VALVES PROPERLY DURING INITIAL MUNITION LINE SETUP. CAUSE(S) A. OPERATOR ERROR.	AGENT WILL NOT DRAIN TO THE ADS AND MAY BE DRAINED ELSEWHERE, AS THE PRIMARY ANOMALY TO EQUIPMENT.	FAILURE DETERRENCE PERSONNEL TRAINING, PROCEDURES SPECIFY VALVE POSITIONING DURING SETUP.	1	4	4

FMEA INFORMATION SOURCES

BB NO. 26 PIPING

DRAWINGS/DOCUMENTS:

o Draft Demil Plan for CAMDS at Tooele Army Depot

PERSONNEL REFERENCED:

Lt. J. King

CRITERIA NOTES:

Design Criteria for CAMDS Piping Project, 28 July 1975

Analysis Limited to Agent Piping

OTHER:

Memo for record: SAREA-DM, 26 June 1975.
Piping Interface Meeting , Salt Lake City, 24 June 1975.
(J. K. Bartel)

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [X]
COMPONENT LEVEL [ ]

BUILDING BLOCK: NO. 27. ELECTRICAL (ELE)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY NUMBER
27.0	ELECTRICAL SYSTEM	SUPPLY AND DISTRIBUTE COMMERCIAL AND EMERGENCY STANDBY POWER.		EQUIPMENT				
27.1	12 KV LINE TO CAMDS, 120/208 V TRANSFORMERS, 480 V TRANSFORMERS, MAIN CIRCUIT BREAKERS	PRIMARY ELECTRICAL POWER TO ALL 120/208 V AND 480 V LOADS.	MODE - INTERRUPTION. CAUSE(S) A. LINE FAILURE, LIGHTNING, UTILITY FAILURE, TRANSFORMER FAILURE, OVERLOAD OF MAIN BREAKERS, HUMAN ERROR.	LOSS OF ELECTRICAL POWER TO FACILITY CAUSING UNSCHEDULED SHUTDOWN OF ALL OPERATIONS. o FURNACES WOULD NOT SUSTAIN COMBUSTION, CAUSING POSSIBLE BUILDUP OF COMBUSTIBLE GASES WITH A CHANCE REIGNITION AND EXPLOSION RELEASING AGENT TO CONTAINED AREA. o ADS PROCESS WOULD STOP WITH POSSIBLE EXPLOSION DUE TO BUILDUP OF TOXIC AND AGENT GASES. POSSIBLE RELEASE OF AGENT AND TOXIC GAS TO THE ATMOSPHERE. THIS IS A POSSIBLE RESULT OF THE LOSS OF AGITATION AND/OR COOLING. SEE BB. NO. 13.	FAILURE DETERRENCE EMERGENCY GENERATORS AUTOMATICALLY PICK UP THOSE LOADS WHICH ARE NECESSARY TO THE ORDERLY SHUT DOWN OF ALL PROCESSING OPERATIONS. THE GENERATORS WILL BE ON LINE WITHIN 10 SECONDS OF POWER FAILURE TO THE FOLLOWING LOADS: 120/208 V SYSTEM (THERE ARE TWO 235-KW 120/208V GENERATORS. IN THE EVENT OF FAILURE OF ONE UNIT THE SECOND WILL AUTOMATICALLY COME ON LINE.) MCC-E CONTROL CENTER UPA FILTER BIF FILTER PDF FILTER (INPUT) AREA LIGHTING HOIST BIF DOCK MPF FILTER MME FILTER ECC FILTER PIP FILTER PANEL E1 - AT POWER DISTRIBUTION MODULE. LIGHTING EXHAUST FAN TELEPHONE EXCHANGE HEATER	1	4	4

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [X]
COMPONENT LEVEL [ ]

BUILDING BLOCK: NO. 27. ELECTRICAL (ELE)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
27.1	12 KV LINE TO CAMDS, 120/208 V TRANSFORMERS, 480 V TRANSFORMERS, MAIN CIRCUIT BREAKERS (CONTINUED)			PERSONNEL LOSS OF LIGHTING WITH POSSIBLE INJURY TO PERSONNEL AND EQUIPMENT. OF SPECIFIC CONCERN ARE THOSE AREAS WHERE PERSONNEL ARE WORKING IN TYPE A SUITS, AND THE CONTROL CENTER.	FAILURE DETERRENCE PANEL E2 - AT CONTROL MODULE. LIGHTING HEATER/AIR CONDITIONER PANEL E3 - AT CONTROL MODULE. ECC POWER/CONTROL ADS CONTROL MANUAL CONTROLS AGENT INCINERATOR POWER/CONTROL DFS CONTROL/POWER MPF CONTROL/POWER ETS/CDC CONTROL/POWER COMPUTER CTV PANEL E4 - AT RR CAR WITH GENERATORS. LIGHTING WATER PUMP HEATERS LOAD BANK FUEL PUMPS BATTERY CHARGER RELAY KIM START (WATER HEATER ON BLOCK OF GENERATORS) (SEE 480V SYSTEM BELOW FOR ADDITIONAL 120/208 V LOADS.) 480 V SYSTEM - (ONE 500-KW GENERATOR). AIR COMPRESSOR BOILER ADS MPF DFS UTILITIES HOUSING 120/208V PANELBOARD EMERGENCY BATTERY LANTERNS WITH BUILT-IN CHARGERS AND AUTOMATIC TURN ON WHEN THE CHARGING CIRCUIT IS INTERRUPTED WILL BE INSTALLED IN ALL WORK AREAS TO COVER THE 10 SECONDS LOSS OF POWER.			

FMEA INFORMATION SOURCES

BB NO. 27 ELECTRICAL SYSTEM

DRAWINGS/DOCUMENTS:

27-500-1	24 May 75	27-500-16	24 May 75	27-501-10	24 Feb 75
-2	24 May 75	-17	24 May 75	-11	20 Feb 75
-3	27 May 75	-18	27 Sep 73	-12	9 June 75
-4	27 May 75	-19	15 Aug 73	-13	17 Dec 75
-5	27 May 75	-20	23 Apr 72	-14	16 Dec 74
-6	27 May 75	27-511-01	14 Feb 75	-15	16 Dec 74
-7	27 May 75	27-501-1	7 June 75	-16	6 Jan 74
-8	27 May 75	-2	30 Apr 73	-17	2 Oct 72
-9	27 May 75	-3	3 Apr 73	-18	3 Dec 73
-10	27 May 75	-4	23 Apr 73	-19	14 Mar 75
-11	9 June 75	-5	28 Feb 73	-20	4 Feb 75
-12	20 May 75	-6	9 June 75	-21	30 Dec 74
-13	20 May 75	-7	9 June 75	-22	10 Sep 74
-14	24 May 75	-8	19 Nov 74	-23	18 June 75
-15	7 June 75	-9	24 Feb 75	-24	30 May 75
				-25	3 July 75

PERSONNEL REFERENCED:

D. Bodrero

L. Selin

CRITERIA NOTES:

- o Review limited to major impact areas.
- o Design not reviewed for adequacy in size or conformity to building codes.
- o Analysis limited to first level of failure only.

OTHER;

- o Draft Demil Plan for CAMDS at Tooele Army Depot
- o Memo for record - Report of meeting on CAMDS Electrical and Control Interfaces - SAREA-DM, 25 Jul 75, J. W. Cauller
- o Disposition AMXTE-AEO, CAMDS Electrical System, 14 July 1975.

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [X]
COMPONENT LEVEL [X]

BUILDING BLOCK: NO. 30. CLOSED CIRCUIT TELEVISION (CTV)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
30.0	CLOSED CIRCUIT TELEVISION SYSTEM	VISUAL MONITORING OF WORK AREAS DURING PROCESSING AND MAINTENANCE OPERATIONS. VISUAL MONITORING OF CRITICAL UNMANNED HAZARDOUS AREAS DURING PROCESSING OPERATIONS.		EQUIPMENT	FAILURE DETERRENCE A SPARE GENERATOR AND AMPLIFIER ARE MOUNTED NEXT TO PRIMARY UNIT. REPLACEMENT OF PRIMARY UNIT IN THE SYSTEM REQUIRES DISCONNECTING ONE CABLE FROM THE PRIMARY UNIT AND CONNECTION TO THE SPARE. A B&C CONNECTOR IS USED AT THE INTERFACE.	1	4	4
30.1	CENTRAL SYNCHRONIZATION GENERATOR AND AMPLIFIER	SINGLE SOURCE OF SYNCHRONIZATION SIGNAL FOR ALL TV CAMERAS AND MONITORS.	MODE - ERRATIC OPERATION OR COMPLETE FAILURE. CAUSE(S) A. COMPONENT FAILURE.	TOTAL LOSS OF VISUAL (TV) MONITORING REQUIRING SHUTDOWN OF OPERATIONS UNTIL REPAIRED.				

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [X]

COMPONENT LEVEL [X]

BUILDING BLOCK: NO. 31. COMMUNICATIONS (CON)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
31.0	COMMUNICATION SYSTEM	VERBAL COMMUNICATIONS BETWEEN ALL WORK AREAS WITHIN CAMDS INCLUDING: PUBLIC ADDRESS TELEPHONE INTERCOM LEVEL A SUITED PERSONNEL AUDIO MONITOR AT PUBLIC ADDRESS LOCATIONS.						
31.1	EXTENSION CIRCUITS	INTERCONNECT CIRCUITS FROM/TO COMMUNICATION POINTS.	MODE - COMPONENT FAILURE PREVENTING PROPER CIRCUIT CONNECTION.	PERSONNEL A. LOSS OF PERSON-TO-PERSON OR CONFERENCE LINE COMMUNICATION.	FAILURE DETERRENCE A. PREVENTIVE MAINTENANCE PROGRAM.	1	2	2
				B. LOSS OF PUBLIC ADDRESS AND AUDIO MONITOR AT PUBLIC ADDRESS LOCATIONS.	B. PREVENTIVE MAINTENANCE PROGRAM.	2	2	4

FMEA INFORMATION SOURCES

BB NO. 31 COMMUNICATION SYSTEM

DRAWINGS/DOCUMENTS:

31-502-1	24 Apr 75
-2	3 Apr 75
-3	12 Nov 73
-4	(unreadable date)
-5	10 Feb 75

PERSONNEL REFERENCED:

F. Eldridge

CRITERIA NOTES:

- o Identify single items which affect total system performance. (None found to depth studied.)
- o Public Address System viewed as last resort emergency system.

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [X]
COMPONENT LEVEL [ ]

BUILDING BLOCK: NO. 35. SITE CONTROL SYSTEM (SCS)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
35.0	SITE CONTROL SYSTEM	MASTER CONTROL AND MONITORING OVER THE CAMDS SITE. CONTROL IS ACCOMPLISHED BY COMPUTER BASED AUTOMATIC SYSTEM WITH MANUAL OVERRIDE. MONITORING IS ACCOMPLISHED BY COMPUTER BASED AUTOMATIC SYSTEM WITH PARALLEL VISUAL STATUS INDICATORS. THE FOLLOWING ARE SCS CONTROLLED AND MONITORED: EXPLOSIVE CONTAINMENT CUBICLE ROCKET DEMIL MACHINE PROJECTILE DEMIL MACHINE PROJECTILE PULL AND DRAIN MACHINE CONVEYORS MORTAR DEMIL MACHINE MINE DEMIL MACHINE PIPING SYSTEM						

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☒
COMPONENT LEVEL ☐

BUILDING BLOCK: NO. 35. SITE CONTROL SYSTEM (SCS)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
35.0	SITE CONTROL SYSTEM (CONTINUED)	THE FOLLOWING ARE SEPARATELY CONTROLLED AND SCS MONITORED: UNPACK AREA DEACTIVATION FURNACE SYSTEM METAL PARTS FURNACE UTILITIES MODULE AGENT DESTRUCTION SYSTEM EXPLOSIVE TREATMENT SYSTEM CENTRAL DECON SYSTEM BULK ITEM FACILITY FILTER SYSTEM AGENT DETECTORS THE FOLLOWING ARE SEPARATELY CONTROLLED AND MONITORED: DAMAGE INCINERATOR SYSTEM ELECTRICAL DISTRIBUTION SYSTEM PERIMETER MONITORING SYSTEM CLOSED CIRCUIT TELEVISION SYSTEM COMMUNICATIONS SYSTEM CHEMICAL LABORATORY						

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 35. SITE CONTROL SYSTEM (SCS)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
35.1	SOFTWARE PROGRAM	PREDETERMINED SEQUENCE OF OPERATIONS.	MODE - ERROR IN PROGRAMMING.	EQUIPMENT OUT OF SEQUENCE OPERATIONS CAUSING POSSIBLE EQUIPMENT DAMAGE.	FAILURE DETERRENCE PROOFING OF THE PROGRAM IS ACCOMPLISHED DURING TEST RUNS USING INERT MUNITIONS, PRIOR TO PRODUCTION USING ACTIVE MUNITIONS.	2	4	8
	CRT TERMINAL	DISPLAY STATUS OF ACTIVITY INCLUDING EQUIPMENT MALFUNCTION IDENTIFICATION.	MODE - FAILURE TO DISPLAY. CAUSE(S) COMPONENT FAILURE.	PERSONNEL EITHER THE OPERATOR OR MONITOR WILL BE WITHOUT DISPLAY.	FAILURE DETERRENCE A BACK-UP UNIT IS OPERATED IN THE ADJACENT CONTROL POINT.	1	2	2
	TERMINAL PRINTER	HARD COPY PRINTOUT OF COMPUTER SYSTEM ACTIVITIES.	MODE - FAILURE TO MAKE HARD COPY OF DESIRED DATA. CAUSE(S) COMPONENT FAILURE.	PERSONNEL INCOMPLETE RECORDS.	FAILURE DETERRENCE A BACK-UP UNIT IS OPERATED IN THE ADJACENT CONTROL POINT.	1	2	2
	MOVING HEAD DISC	MEMORY FOR COMPUTER SOFTWARE.	MODE - FAILURE TO ISSUE OR RECEIVE DATA ON REQUEST. CAUSE(S) COMPONENT FAILURE.	EQUIPMENT SHUTDOWN OF DEMIL PRODUCTION.	FAILURE DETERRENCE ROUTINE MAINTENANCE PROGRAM.	1	2	2
	COMPUTER MAIN FRAME	CORE MEMORY AND CENTRAL PROCESSING UNIT.	MODE - FAILURE TO OPERATE. CAUSE(S) COMPONENT FAILURE.	PERSONNEL INABILITY TO CONTROL DEMIL OPERATIONS/ POSSIBLE DAMAGE TO EQUIPMENT AND INJURY TO PERSONNEL.	FAILURE DETERRENCE ROUTINE MAINTENANCE PROGRAM.	2	2	4

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL: ☒

BUILDING BLOCK: NO. 35. SITE CONTROL SYSTEM (SCS)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
35.1	SOFTWARE PROGRAM (CONTINUED)							
	COMPUTER SYSTEM	CONTROLS SEQUENCE OF COMMANDS IN ACCORDANCE WITH SOFTWARE PROGRAM. MONITORS FEEDBACK SIGNALS TO ASSURE THAT COMMANDS HAVE BEEN IMPLEMENTED. MONITORS "DOWN STREAM" SYSTEMS TO ASSURE THAT TOTAL PRODUCTION LINE IS FUNCTIONING CORRECTLY. SHUTS DOWN PRODUCTION LINE IN A CONTROLLED SEQUENCE IN EVENT OF MALFUNCTION OF DEMIL AND CONVEYOR EQUIPMENT.	MODE - LOSS OF POWER.	EQUIPMENT A. IN PROCESS DATA ARE STORED IN COMPUTER. B. FURTHER COMMANDS ARE NOT ISSUED. C. COMPUTER PROGRAM STOPS. D. RELAYS WILL OPEN, STOPPING ALL MACHINERY.	FAILURE DETERRENCE RESTART OPERATIONAL PROCEDURE WHICH INCLUDES: o VERIFICATION OF STATUS OF ALL EQUIPMENT. o RESTART AT APPLICABLE PROGRAM STEP.	1	4	4
	MULTIPROGRAMMER	CONTROL SWITCH FOR MOTORS, SOLENOID VALVES, ETC. CONNECTS CONTROLLED UNIT TO GROUND.	MODE - SWITCH FAILURE IN CLOSED MODE. CAUSE(S) COMPONENT FAILURE.	EQUIPMENT UNSCHEDULED OPERATION OF MOTORS, VALVES, ETC. POSSIBLE DAMAGE TO EQUIPMENT AND/OR INJURY TO EQUIPMENT. *THE SEVERITY LEVEL IS INDETERMINATE. THE TIMING OF THE EVENT COULD RESULT IN ANY LEVEL FROM 1 TO 4.	FAILURE DETERRENCE FEEDBACK SIGNALS WILL INDICATE A SCHEDULED CONDITION TO THE COMPUTER AND POSITION INDICATOR LIGHT PANEL. THE COMPUTER WILL AUTOMATICALLY SHUT DOWN THE DEMIL OPERATIONS. NOTE: NOT ALL CONTROLLED ITEMS HAVE FEEDBACK TO THE SCS.	*	2	*

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [ ]
COMPONENT LEVEL [X]

BUILDING BLOCK: NO. 35. SITE CONTROL SYSTEM (SCS)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
35.2	MANUAL OVERRIDE SWITCH PANEL	MANUAL OPERATION OF DEMIL PROCESS AS AN OVERRIDE OF THE COMPUTER SYSTEM. ANTICIPATED USE DURING MAINTENANCE PERIODS AND SPECIAL EVENTS.	MODE - OPERATOR ERROR IN SELECTING SWITCHES.	PERSONNEL UNEXPECTED OPERATION OF MOTORS, CLAMPS, PUMPS, DOORS, ETC., WITH POSSIBLE DAMAGE TO EQUIPMENT AND/OR INJURY TO PERSONNEL. *THE SEVERITY LEVEL IS INDETERMINATE. THE TIMING OF THE EVENT COULD RESULT IN ANY LEVEL FROM 1 TO 4.	FAILURE DETERRENCE PANEL OPERATIONS ARE ONLY POSSIBLE THROUGH USE OF A KEY WHICH IS RETAINED BY A CAMDS SUPERVISOR. THE KEY SWITCH IS INTERLOCKED WITH THE COMPUTER. USE OF THE KEY BLOCKS ALL COMPUTER GENERATED COMMANDS FROM THE CONTROLLED EQUIPMENT. A DETAILED OPERATION MANUAL (COOK BOOK TYPE) WILL BE USED TO OPERATE THE MACHINE SEQUENCES.	*	1	*
35.3	POSITION INDICATOR LIGHT PANEL	VISUAL INDICATION OF FEEDBACK/STATUS SIGNALS.	MODE - INCORRECT/NO READOUT. CAUSE(S) LAMP OR OTHER COMPONENT FAILURES.	PERSONNEL OPERATOR ACTIONS COULD BE IN ERROR DUE TO WRONG INFORMATION CAUSING EQUIPMENT DAMAGE AND/OR PERSONNEL INJURY.	FAILURE DETERRENCE THIS PANEL IS A BACKUP FOR THE COMPUTER SYSTEM. THE PANEL HAS A LAMP TEST BUTTON ON THE FRONT OF THE PANEL. LAMP STATUS IS INDICATED IN THE MANUAL OPERATION MANUAL.	1	2	2
35.4	CONTROL CIRCUIT WIRING	SWITCHING CIRCUITRY FOR MOTORS, SOLENOID VALVES ETC., FOR DEMIL PROCESSING.	MODE - CIRCUIT GROUNDING BETWEEN THE CONTROLLED DEVICE AND ITS CONTROL SWITCH. CAUSE(S) INSULATION FAILURE AND/OR CONTACT OF CONDUCTOR TO GROUND. THE IMPACT OF DECON SOLUTION ON CONVENTIONAL INSULATION IS UNKNOWN. OVER THE LIFE OF THE PROGRAM IT IS EXPECTED THAT THE DECON SOLUTION WILL CONTACT THE WIRING OF THE DEMIL MACHINES.	PERSONNEL UNSCHEDULED OPERATION OF DOORS, FANS, SAWS, PUMPS, PUNCHES, CLAMPS, CONVEYORS, ETC., CAUSING POSSIBLE DAMAGE TO EQUIPMENT AND/OR INJURY TO PERSONNEL. *THE SEVERITY LEVEL IS INDETERMINATE. THE TIMING OF THE EVENT COULD RESULT IN ANY LEVEL FROM 1 TO 4.	FAILURE DETERRENCE FEEDBACK SIGNALS WILL INDICATE AN UNSCHEDULED CONDITION. THE LIGHT PANEL WILL INDICATE THE FEEDBACK CONDITION. THE COMPUTER WILL AUTOMATICALLY SHUT DOWN THE DEMIL OPERATIONS. (NOTE: NOT ALL CONTROLLED ITEMS HAVE FEEDBACK TO THE SCS) CORRECTIVE ACTION RECOMMEND CONSIDERATION OF WIRING SWITCHING DEVICES IN THE HOT LEAD OF THE CIRCUITS PER NATIONAL ELECTRIC CODE.	*	4	*

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL ☐
COMPONENT LEVEL ☒

BUILDING BLOCK: NO. 35. SITE CONTROL SYSTEM (SCS)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
35.5	BLAST SENSORS INSIDE ECC	SOURCE OF FEEDBACK SIGNAL IN EVENT OF BLAST INSIDE ECC--SIGNAL IS USED BY THE COMPUTER TO HALT ALL ECC PROCESSING AND TO SHUT OFF THE HYDRAULIC RETURN LINE.	MODE - FAILURE TO OPERATE WITH OVERPRESSURE.	EQUIPMENT CONTINUED PROCESSING WHICH COULD RELEASE AGENT (THROUGH DOORS OPENING) TO THE FILTRATION SYSTEM AND MIXING OF AGENT WITH HYDRAULIC FLUIDS. IF FIRE WERE PRESENT, IT COULD PROPAGATE OUTSIDE THE ECC.	FAILURE DETERRENCE ROUTINE MAINTENANCE AND CALIBRATION OF SENSORS. REDUNDANT SENSORS ARE INSTALLED FOR THE SCS AND HYSRAULIC PUMP.	3	1	3
35.6	MIRCO SWITCHES	SOURCE OF FEEDBACK SIGNAL FOR "POSITION" OF CLAMPS, DOORS, LOCKS, SAWS, ETC.	MODE - FAILURE TO CHANGE STATE WITH EVENT.	EQUIPMENT ERROR IN SIGNAL TO COMPUTER WHICH WILL PERMIT CONTINUATION TO THE NEXT STEP OR STOP THE PROCESS WHEN THE OPPOSITE SHOULD OCCUR.	FAILURE DETERRENCE COMPUTER SOFTWARE PROGRAMS REQUIRE TESTING THE SWITCH CONDITION PRIOR TO AND AFTER EACH EVENT. IN THE EVENT THE DETECTOR SIGNAL IS IN ERROR, THE PROCESS IS STOPPED.	1	4	4
35.7	MOTION SENSORS	SOURCE OF FEEDBACK SIGNAL TO SHOW CONVEYOR OPERATION.	MODE - FAILURE TO PROPERLY FEEDBACK CONVEYOR STATUS.	EQUIPMENT ERROR IN SIGNAL TO COMPUTER WHICH WILL PERMIT CONTINUATION TO THE NEXT STEP OR STOP THE PROCESS WHEN THE OPPOSITE SHOULD OCCUR.	FAILURE DETERRENCE COMPUTER SOFTWARE PROGRAMS REQUIRE TESTING THE CIRCUIT PRIOR TO AND AFTER EACH EVENT. IF THE SENSOR FAILS TO SHOW MOTION, WHEN PROGRAMMED, THE COMPUTER PROGRAM STOPS THE CONVEYOR MOTOR AND AUTOMATICALLY RESTARTS THE MOTOR. IF THE CONVEYOR AGAIN FAILS TO SHOW MOVEMENT, THE DEMIL PROCESSING IS AUTOMATICALLY STOPPED.	2	1	2

FAILURE MODE AND EFFECT ANALYSIS

BUILDING BLOCK LEVEL [ ]
COMPONENT LEVEL [X]

BUILDING BLOCK: NO. 35. SITE CONTROL SYSTEM (SCS)

	COMPONENT OR ITEM	FUNCTION	FAILURE MODE/CAUSE	FAILURE CONSEQUENCE EQUIPMENT/PERSONNEL	FAILURE DETERRENCE OR CORRECTIVE ACTION	SEVERITY LEVEL	FREQUENCY OF FAILURE	CRITICALITY INDEX
35.8	ECC OVERRIDE CIRCUITS	FURNISH PERSONNEL SAFETY WHEN MAINTENANCE AND REPAIR WORK IS DONE INSIDE THE ECC. A KEY SWITCH IS LOCATED OUTSIDE THE ECC. PRIOR TO ENTRY IN THE ECC THE KEY IS GIVEN TO THE MEN ENTERING. REMOVAL OF THE KEY INHIBITS ALL CONTROL CIRCUITS WITHIN THE ECC. BUTTONS ARE INSTALLED AT THE ENDS OF THE ECC. HOLDING THE BUTTON DOWN PERMITS OPERATION OF THE CONTROL CIRCUITS FROM THE CONTROL CENTER.	MODE - ONE MAN HOLDS THE BUTTON DOWN WHILE THE SECOND WORKS ON THE EQUIPMENT. THE WRONG SAW, CLAMP, ACTUATOR, PUNCH, ETC., ARE OPERATED FROM THE CONTROL CENTER.	PERSONNEL POSSIBLE INJURY TO PERSONNEL.	FAILURE DETERRENCE STANDARD OPERATING PROCEDURE AND PERSONNEL TRAINING IN ACCORDANCE WITH THE PROCEDURE. RELEASE OF THE BUTTON STOPS FURTHER OPERATIONS.	3	3	9

FMEA INFORMATION SOURCES

BB NO. 35 SITE CONTROL SYSTEM

DRAWINGS/DOCUMENTS:

35-504-1	13 Aug 74	35-504-10	14 Mar 75	35-504-19	15 Sep 74
-2	7 Aug 74	-11	14 Mar 75	-20	30 Jan 75
-3	4 Oct 74	-12	14 Mar 75	-21	14 Mar 75
-4	13 Aug 74	-13	14 Mar 75	-22	10 Feb 75
-5	30 July 74	-14	13 Sep 74	-23	12 Nov 74
-6	20 June 74	-15	13 Oct 74		
-7	25 June 74	-16	18 Oct 74		
-8	13 Sept 74	-17	9 May 75		
-9	24 Oct 74	-18	10 Sep 74		

PERSONNEL REFERENCED:

AEO (TEAD) personnel - D. Bodrero, N. Glick, L. Selin

Hewlett-Packard personnel - S. Nelson and L. Souza

CRITERIA NOTES:

- o Review limited to major impact areas.
- o Software review limited to general structures only. Software will shutdown preceding operations in event of failure. Software will shutdown operations in event of failure in monitored building blocks.
- o Computer diagnostic test will be run each day prior to start up.
- o Design not reviewed for adequacy in size or conformity to building codes.
- o Emergency shutdown procedures are not developed and not reviewed.

5. SUMMARY AND CONCLUSION

For purposes of this document, Safety Analysis and Hazard Evaluation Report, Failure Modes and Effects Analyses, the emphasis has been placed on identified events (agent release, toxic leaks, explosions, and fire) which could pose a hazard to assigned personnel, equipment, or the surrounding environment. No single point failures were found to exist anywhere in the CAMDS building blocks that could conceivably result in Category IV (catastrophic) conditions; two or more failures were required to bring about Category IV results, suggesting that considerable attention has been given to the basic design concepts of each building block.

5.1 ENVIRONMENTAL CONSIDERATIONS

Based on an examination of all the available design and test data for the CAMDS facility at Tooele, Utah, deleterious effects to the environment as a result of demilitarization operations are not probable. The amount of agent being processed in any one operation is of a sufficiently small quantity as to be completely contained and absorbed by a network of filter systems. An accidental spill of agent GB, VX, or mustard is readily and safely handled. Further, the facility is designed to isolate one activity from another in an independent and completely autonomous manner.

The possible emission of chemical agent vapors to the atmosphere resulting from an accidental spill outside of the detoxification areas is the only adverse environmental effect associated with the CAMDS concept. Since only one munition will be involved, the release is limited to the amount of agent in that particular munition. Throughout the demilitarization operations a network of detectors will provide accurate and immediate indication of contamination. If an area of contamination is detected, that area will be chemically decontaminated within minutes and checked to verify that there is no detectable concentration of agent present. Throughout the FMEA data (Section 4), possible agent leakage or spillage is noted as leaking only into a low pressure or filtered area or to caustic scrubbing system, not to the atmosphere; Reference Explosive Containment Cubicle, building blocks (BB) No. 2., items 2.2, 2.3, 2.4. Release of toxic agents to caustic scrubbing areas is noted in Deactivation Furnace System, BB No. 4, items 4.3 and 4.5; Agent Destruction System, BB No. 13., item 13.1. A possible release to fume burners and to afterburners with failures in the

Metal Parts Furnace, BB No. 5, is noted in items 5.1 and 5.2. Of the major failures noted as possible in the Bulk Item Facility, BB No. 21., a rupture in the tank drain line would release agent to a toxic area (item 21.2). If a container is damaged there may be toxic release to an outside area as noted in item 21.1 but considerable testing and experience with container handling indicates this to be a very remote likelihood (reference item 21.1). Additionally, personnel in the immediate area are suited appropriately, decontamination solution is readily available and safety procedures are provided to handle any eventuality.

The afterburner in the Deactivation Furnace/System operates at a minimum temperature of 1600°F; thus, all traces of agents GB or VX that may be present in the Deactivation Furnace gaseous effluent are thermally decomposed. Fiberglass shipping and firing tubes are burned in the Deactivation Furnace/Scrubber at a temperature that minimizes particulate emissions.

No solid waste problems are envisioned because the wood dunnage and combustible packing materials are incinerated on site. There is no discharge of process water nor toxic wastes from the CAMDS site. All brine resulting from the neutralization of agents, scrubbing of waste gas streams, and decontamination processes will be dried on site with the resulting solids placed in storage.

5.2 SAFETY CONSIDERATIONS

Safety considerations have been rigorously executed in the design of the CAMDS facility currently under construction at Tooele, Utah. Experience obtained at Rocky Mountain Arsenal and as a result of numerous tests conducted at Edgewood Arsenal has resulted in the employment of numerous safety measures in the basic design. These design features which augment safety throughout the CAMDS are:

- Fail-safe features on valves, actuators, micro switches, etc.
- Filter ventilation systems
- Numerous air changes per hour in toxic areas (up to 25/hr)
- Detector systems (stacks, detox areas, etc.)
- Alarm systems (audible for entire CAMDS site)
- Back-up systems (standby)

- Redundancy (electrical, storage tanks, etc.)
- Perimeter monitoring (eight stations)
- Airlocks (isolation of one area from another)
- Closed circuit television surveillance
- Automatic flame safeguard controls and alarm on furnaces
- Automatic temperature controllers
- Explosive containment cubicle (certification via tests)
- Fire hydrant system (serves all areas)
- Communications system (serves all areas)
- Burster sensor station (determines existence of burster)
- Projectile positioning sensors (provides for critical alignment)
- Sump drain - level detectors
- Computer controlled - automatic shutdown
- Negative pressure in toxic areas.

All the above are well covered in the CAMDS Demilitarization Plan and other documents referenced in Section 3.2 herein.

Safety, impeccable safety, has been a primary goal of the CAMDS design since inception. In evidence of this, prior to introduction of munitions (possibly unsafe-leaking or ruptured) into the CAMDS area, operational procedures require inspection at the storage igloo. Again, after transport to CAMDS site and before entering the Unpack Area they are reinspected as noted in FMEA data for building block, No. 1, item 1.4. The expected frequency of a leaking munition entering the UPA undetected is very low, with mines the most serious suspect. Since mines are packed three to a closed container, and are thin-walled, removal of individual mines in the Unpack Area is accomplished by personnel wearing Level B protective clothing. This is noted in FMEA item 1.4 with an assigned low probability of occurance.

The munition route following the Unpack Area is the Explosive Containment Cubicle (BB No. 2), containing four different Demil machines separately operational with a good chance of explosive/fire incident. But the ECC is designed for explosive containment. The FMEA data chart for item 2.1 assesses the possibility of an incident as high, (3). Also, with a high expected failure frequency is seal failures,due to personnel wear, equipments abrasion,exposure to decontamination solution and oil, and to

ordinary mechanical use wear. A periodic seal maintenance program will mitigate the adverse effects of seal misuse; however, the explosive incident type of failure is a randomly occurring type anomaly and will depend on good design and conclusive test results for containment. If the ECC doors or walls rupture,the severity level would be high, due to agent release to the ECC housing, or due to flying debris. These eventualities are covered in FMEA items 2.1, 2.2 and 2.3.

Advancement of the munitions in the demil operations by conveyors to the furnaces and explosive agent destruction operations have been reviewed with possible failure modes, fire, toxic release, and deterrant actions indicated in the respective FMEA data sheet items. The failure modes attributable to the Agent Destruction System result in possible high severity levels as shown in FMEA item 13.1, but accompanying probability of occurance is very low. Referring to the FMEA charts on the Explosive Treatment System, BB No. 14, all identified failure modes are low in severity and frequency levels. Failure modes identified with the Bulk Item Facility, BB No. 21., have very low failure probabilities as noted on the applicable FMEA data sheets. Examination of all FMEA data sheets on the Deactivation Furnace System and the Metal Parts Furnace shows that in no case is the combined criticality index higher than four. That is, no combination of severity level and probable frequency of failure results in more than a mediocre criticality for the identified failure mode, a result almost entirely of good design and attention to safety considerations in areas of high energy production.

System safety engineering, in compliance with the intent and purpose of MIL-STD-882, has been demonstrated throughout the design phase of the CAMDS. Conduct of the Safety Analyses and Hazard Evaluation (FMEA) as presented herein, has resulted in recognition of safety provisions for all identified hazardous conditions, such as:

- Release of toxic materials to the atmosphere
- Uncontrolled explosions
- Uncontrolled fire
- Critical equipment failure.

No single point failures were found to exist which could result in any of the aforementioned hazardous conditions.

5.3 OPERATIONAL CONSIDERATIONS

An assessment of the sequence of events which comprise the process flow for any given munition being demilitarized in the CAMDS reveals no operational weaknesses. The integration of the semi-autonomous building blocks into a total system concept provides for a unique operational entity. The operational features provide for the pre-inspection of all munitions prior to conveyance to the Unpack Area. Removal of explosive components within the confines of the ECC using remotely operated demilitarization machinery provides for maximum safety to operating personnel. The destruction of explosive components by thermal oxidation in the DFS provides safe and efficient operation. Residual agent contamination of metal parts is nullified by heat treatment in the MPF. Chemical neutralization of agents GB and VX in the ADS has been rendered safe and fully automated. Destruction of the chemical agent mustard in the MPF has been demonstrated to be both economical and safe at other installations.

Virtually all operations contemplated for CAMDS are an improvement to and an extension of proven systems developed by the U.S. Army over the past 6 years. Numerous tests have been conducted and documented, which have resulted in the establishment of procedures governing the operations at the CAMDS at Tooele, Utah. For each and every operation planned for CAMDS , a specific series of tests has been conducted, to prove out esoteric features, safety aspects, efficiency, and human factors.

The inclusion of air locks, personnel showers, backup systems, protective clothing, alarm systems, enunciator systems, television monitoring, communications, the personnel support complex, and the detailed planning and specialized training sessions to be implemented provide an excellent basis on which to evaluate the overall operations concept of the CAMDS.